March 2011

Life Beyond Earth? Pg 19
Herbal Manicure Pg 32

Science Reporter

A CSIR Publication

The SciFi World

Amazing World of Science Fiction

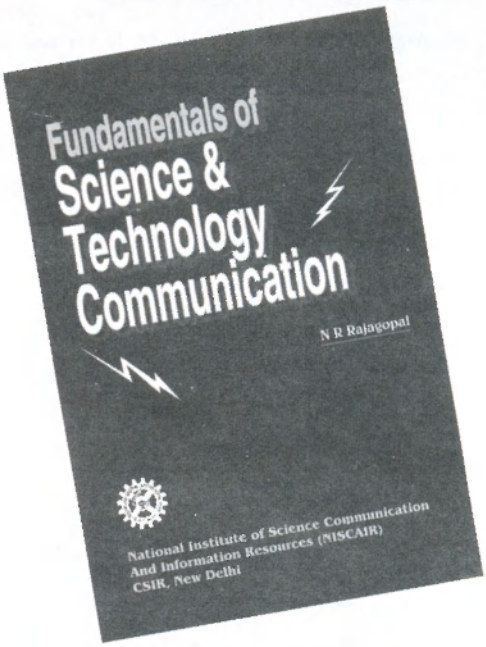
In This Issue

Fundamentals of Science & Technology Communication

New Release

The book *Fundamentals of Science & Technology Communication* covers the whole gamut of science and technology communication, talking about the technicalities and nuances that place a well-written scientific report, theses or any other publication a notch above the rest. The book deals with the structure of communications in organizations and managing internal as well as external communications; the different forms of writing such as technical reports and proposals, progress reports, annual reports etc; writing a scientific paper and scientific communication through journals; oral communication and preparing for interviews and so on. Besides, the book also points out common faults in grammar and language. The book is replete with examples and practical exercises.

Although the book is designed to fulfill the need for a textbook for the course on Technical Report writing taught for all under graduates of BITS, Pilani, it will be a useful guide to all students pursuing higher degrees in Science who need be instructed in the art of bringing out good publications, reports and theses.



Pages: 156

CONTENTS

Science Reporter

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NATIONAL INSTITUTE OF SCIENCE COMMUNICATION AND INFORMATION RESOURCES (NISCAIR)
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH (CSIR)

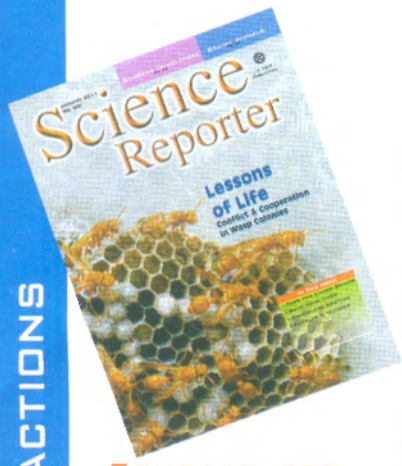
COVER STORY

DEPARTMENTS

REFLECTIONS

SCIENCE FICTION

ARTICLES



CRUSADE FOR SCIENCE COMMUNICATION

You have done a creditable job by exhorting the scientists to take up dissemination of science information in your Editorial **Communicating Science—Huge Responsibility** (January 2011). No doubt scientists have a major role to play in acquainting the public, from time to time, about the recent advances that occur in the domain of science. There should be more material on science subjects, more science journals and more public interest, awareness and participation.

Along the way you have squarely denounced some retrograde tendencies and practices closely related with religion and social norms that over the centuries have made steady inroads in our society and continue to do so.

Meanwhile, in the December 2010 issue, Dr S. Chand and Dr R.C. Parida in the feature article **Millennium Prize for Perelman** have expressed surprise that Mathematics does not occur in the list of Nobel Prizes. It is believed that Alfred Nobel's lady-love deserted him for a mathematician and this piqued him no end. According to the famous Bard, 'Nature hath no fury than a woman scorned' but here we have a scientist behaving irrationally.

Concerning Alfred there is an interesting anecdote. When his younger brother died in a factory accident, a newspaper wrongly reported it as the passing away of the inventor of dynamite—the messiah of death. Perhaps this news prompted him to constitute the Nobel Prize so that posterity may remember him in a better vein.

Shashi, Indore (M.P.)

INDIAN SCIENCE LAGGING BEHIND?

I fully appreciate the Editorial **Indian Science – As the World Sees It** (December 2010), which has given an insight into the state of Indian S&T. It is a matter of great concern that India's share of global patents is barely 2% since most of the patents are granted to foreign companies located in India based on R&D projects carried out of India. India has to improve research in basic sciences so as to be able to get Nobel Prizes in the future. Even though USA's population is only one third that of India, during 110 years of Nobel prizes USA has secured more than 50% Nobel prizes, that is, 328.

Prof Prakash Manikpure, Nagpur

WHERE IS VALUE IN SCIENCE?

In respect of the Nobel in Medicine this year (December 2010 by Dr. M.S.S. Murthy), along with Dr. Edwards the name of Dr. Subhas Mukherjee naturally comes who also could have shared this prize for his remarkable achievements related to IVF and test tube baby. But bad luck to our country and especially for West Bengal. Injustice and manipulation are the prime credentials in the present era for establishment in any field, be it science, literature, sports, music etc.

How much harm envy amongst fellow colleagues can cause, Dr. Mukherjee's pathetic and painful death unveils the same. Herein comes the question of values in science written beautifully by Dr. Nandita (December 2010). Jealousy and violence in any form lessens or destroys human quality. Scientific mind solves, never creates problems.

Dr. S.K. Rudra
Sonamukhi, Bankura (W.B)

GIANTS OF SCIENCE

From what Durga Nath Dhar has written in **Anecdotes** (January 2010) it appears that the relation between Sir Humphry Davy and his protege Michael Faraday was fruitful and cordial. Fruitful yes, but the same cannot be said of cordiality and understanding which somehow enters in a long association when so much is at stake. It is said that Sir Davy opposed Faraday's election to the Royal Society. Either he was jealous of Faraday's meteoric rise (because of his work on electric motor) or he believed that his ward was not ready for the honour. As luck would have it Lady Davy was not kindly disposed towards Faraday and this fact would have had a hand in influencing her husband, who was reputed to be tactless and erratic in spite of his achievements and greatness.

Finally, as far as commonality is concerned, both came from a humble background. While Davy is regarded as the father of electro-chemistry Faraday is known as the father of electric motor. Both the scientists were brilliant researchers who were interested in science for the sake of science only and were reluctant to use their invention for personal gains.

Dr. S.K. Gurtu
Mansarovar, Jaipur

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EDITOR
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ASSOCIATE EDITOR
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KAUSHAL KISHORE
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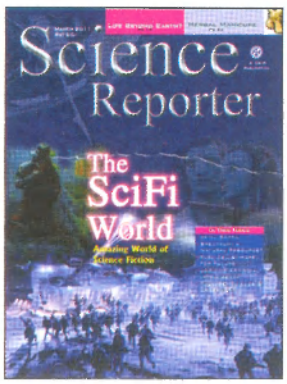

COVER DESIGN
NEERU SHARMA

SHOULDN'T OUR CHILDREN KNOW...?

In a recent interaction with Delhi school kids pursuing science at the higher secondary level, it came as no surprise that, on being asked to name a few achievements of Indian science, the only success story they could put their finger on was space—Chandrayaan, to be more precise. India's incredible success in the field of space science and technology is the most visible manifestation of the country's rise, in just a little more than 60 years after independence, as a powerhouse of cutting edge science and technology. But surely it is not the only one.

When India charted its own independent course about 63 years ago, it was just emerging out of the shadows of the devastating Bengal famine of 1943. It did not have any worthwhile S&T infrastructure, no sound industrial base, almost non-existent health services, and abysmally low agricultural production. Combine this with a vast land mass and a rapidly growing population and the huge challenges before a country struggling to stand on its feet become clear. In fact, "begging bowl era" and "ship-to-mouth existence" are terms that are often used to describe the period just after the country's independence. But the country's keenness to develop a strong indigenous S&T base has brought it to a position where it is capable of competing with far developed countries on everything from space research to vaccines.

The "green revolution" brought about by initial introduction and subsequent development of high-yielding crop varieties within its own laboratories not only helped India feed its masses but filled up its granaries with enough to export as well. The "white revolution" with a combination of R&D and a hugely successful cooperative movement has made India the largest milk producer in the world. Propelled by scientific breakthroughs at India's leading fishery research institutions, the country pushed ahead with a "blue revolution", the rapid increase of fish production in small ponds and water bodies that has made India the third largest producer of fish in the world.

India is also one of the few countries to have mastered the entire nuclear fuel cycle, from mining to reprocessing spent fuel to waste disposal. And, of course, it is one of the few countries in the world to have developed the capability of designing, building, launching and operating its own satellites for a wide range of applications, including TV & radio networking, telecommunication, weather watch, disaster warning, remote sensing for management of natural resources, education and telemedicine. All this despite sanctions on critical technologies.

Denied the use of advanced supercomputers during the 1980s, the country's scientists got down to developing indigenous supercomputers that are today competing among the best in the world market. Low-cost vaccines and drugs have catapulted the Indian pharma industry to the fourth position in the world. The Indian leather industry has been transformed from a mere exporter of raw hides and skins a few decades ago to a vibrant, modern industry that ranks among the top five export earners.

Are these not some of the incredible success stories of Indian science that we should be telling our school children? At least for those with an inclination towards science, accounts of Indian scientists working against all odds and coming up trumps could be motivating and inspiring.

Perhaps, a short account of a few selected success stories of Indian science could be incorporated into the school curriculum at some stage to give the students an insight into the country's journey from scarcity to surplus and from relief to self-reliance.

Hasan Jawaid Khan

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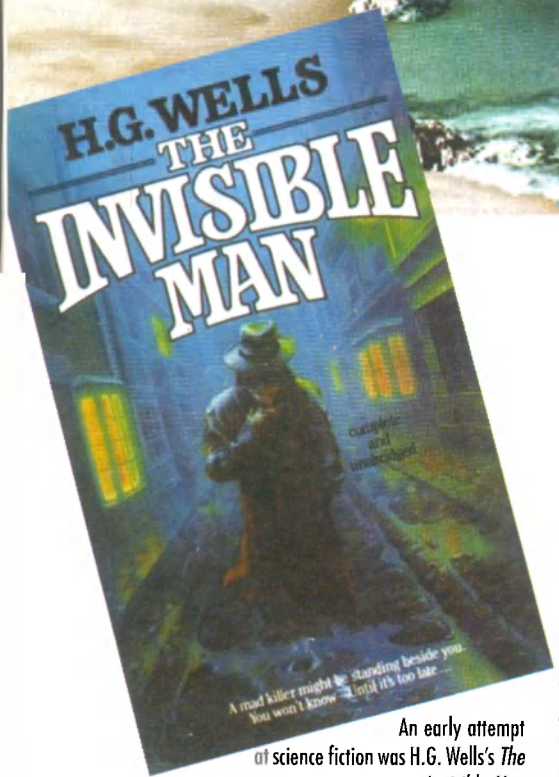
Amazing World of Science Fiction

ARVIND MISHRA

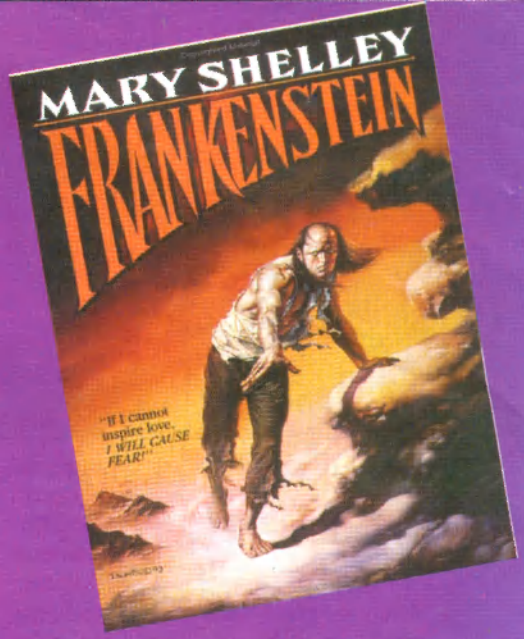


An early attempt at science fiction was H.G. Wells's *The Invisible Man*

GRIFFIN, a scientist, believed that if a person's refractive index was changed to exactly that of air and his body did not absorb or reflect light, then he would be invisible. Griffin successfully carried out this procedure on himself and became invisible. Unfortunately, he could not make himself visible again, and became mentally unstable as a result. Well, Griffin is not a real-life character, as you would have guessed by now. He is the hero of a famous science fiction novel published in 1897—*The Invisible Man* by H.G. Wells.

Imagination is more important than knowledge, said Albert Einstein. Most of us are perhaps not aware of the many worlds totally different from our own that exist in the sub-conscious minds of many imaginative people with prophetic vision whom we recognize as science fiction writers.

Often science fiction writers have been known to possess the predictive talent to foresee the future. Jules Verne (8 February 1828–24 March 1905), the celebrated French novelist, had such a prophetic vision and predicted well in advance man's landing on the moon. Science fiction writers often describe worlds that are quite different from our own though retaining some elements of the one in which we live. But there remains a strong



Frankenstein by Mary Shelley is thought to be the first true science fiction novel

Whether it is predicting the human landing on the Moon or diving into the deep recesses of the oceans, or for that matter even robots and clones, science fiction writers have always had the ability to peer into the future and hazard guesses, often with astounding precision.

possibility that the imagined world of the story might some day come into existence or be discovered.

The pace at which technology is altering our way of life it is very much possible that we are going to have a world quite different from the one inhabited by us. The wonder worlds of science fiction differ from our everyday world in a way that importantly involves science and/or technology in their set up.

Isaac Asimov (2 January 1920–6 April 1992), science fiction writer of world renown, characterizes the genre in these words: "Science fiction story must be set against a society significantly different from our own... usually, but not necessarily, because of some change in the level of science and technology... or it is not a science fiction story." He has also this crisp and concise definition of science fiction: "Science fiction is that branch of literature that deals with human responses to changes in the level of science and technology."

According to Robert A. Heinlein (7 July 1907–8 May 1988), another celebrated science fiction writer of his time, science fiction is "realistic speculation about possible future events, based solidly on adequate knowledge of the real world, past and present, and on a thorough understanding of the nature and significance of the scientific method." Any story that defies the methodology of science is not a science fiction story.

Methodology of science as we know involves steps like sprouting of new curiosities in mind, formulation of a hypothesis and then various tests to verify its validity and reaching the conclusion accordingly. Science fiction must respect the methodology of science and should not be illogical and irrational insofar as the contents and themes of stories are concerned.

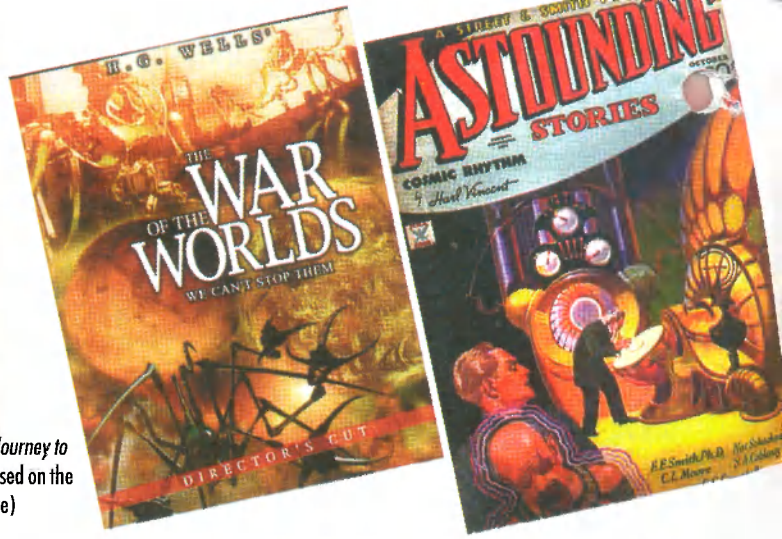
There seems to be an agreement among the majority of science fiction critics that the first true science fiction novel was *Frankenstein* by Mary Shelley (30 August 1797–1 February 1851). She employed a scientific methodology/rationale to persuade the audience that her story took place in the realm of the possible. This magnum opus novel of the author dealt with the possibility that science could even create a monster that can destroy its progenitor, that is, science itself and possibly mankind.

There is a striking resemblance of the ghost Frankenstein with our own mythical character Bhasmasur who tries to kill Lord Shiva even after being blessed by him. But Mary Shelley did not wish her story to be a myth only and made the main character of the novel a scientist and his scientific efforts a focal point of the reader's attention.

Science Fiction Vs Fantasy

Fantasy is usually defined as a work that takes place in a nonexistent and unreal world, such as a fairyland, or concerns incredible and unreal characters while science fantasy employs physical and scientific principles not yet discovered and not contrary to present knowledge. Works of fantasy to which we are very familiar are *Alice's Adventures in Wonderland*, *Lord of the Rings* and the Harry Potter series.

Here authors may enjoy all the liberty to use even far-fetched assumptions like unicorns, multi legged creatures, talking animals and many forms of monsters and ghosts (like Frankenstein!) in their themes of choice. But in science fantasy/fiction



A scene from the movie *A Journey to the Centre of the Earth* based on the novel by H.G. Wells (above)

there must be some possibility that the described characters or events could possibly happen. Miriam Allen de Ford (21 August 1888–22 February 1975) perhaps explains the difference more lucidly: "'Science fiction deals with improbable possibilities, fantasy with plausible impossibilities." It is a common practice amongst science fiction writers to not contradict known scientific facts while the author of fantasy does not feel any such restraints.

Is there any difference in the terms 'science fiction' and 'science fantasy'? Fiction is a Latin word which means 'to invent' while fantasy is a Greek word meaning 'to imagine'. Both are in fact lumped together in general understanding of science fiction and have often been addressed as 'surrealistic fiction' which is simply put as super realistic fiction. In science fiction, science and technology is depicted without any distortions of the facts while in science fantasy even wild imaginations are acceptable like time travel, anti gravity, faster than light (FTL) travels etc. According to Jayant Narlikar, noted Indian science fiction writer, many fantasy elements like journey faster than light could make the science story a bad one despite its good style and form.

Prophetic Vision

Science fiction is known for the ability of its practitioners, that is, the science fiction writers to predict future events. Jules Verne envisioned a submarine run on electric batteries and a rocket to the moon launched from Cape Canaveral, more than a century ago which in turn inspired the making of the first nuclear submarine, the Nautilus, and the Apollo space programmes. Novels of H.G. Wells (21 September 1866–13 August 1946) led to the advent of battle tanks, air forces and atomic bombs. Likewise, Arthur C. Clarke's (16 December 1917–19 March 2008) fictional idea made the geosynchronous satellites a reality, which ultimately led to today's satellite television.

Owing to this capacity of visualizing the future, science fiction writers used to be world-famous, and even consultants with heads of state in many developed countries. Greg Bear (20 August 1951), a celebrated contemporary American science fiction writer, advises the FBI on many issues of crucial strategic importance.

The War of the Worlds by H.G. Wells attracted wide readership

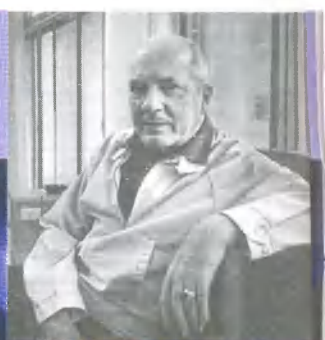
'Astounding Stories', one of the early magazines that published science fiction stories of renowned writers

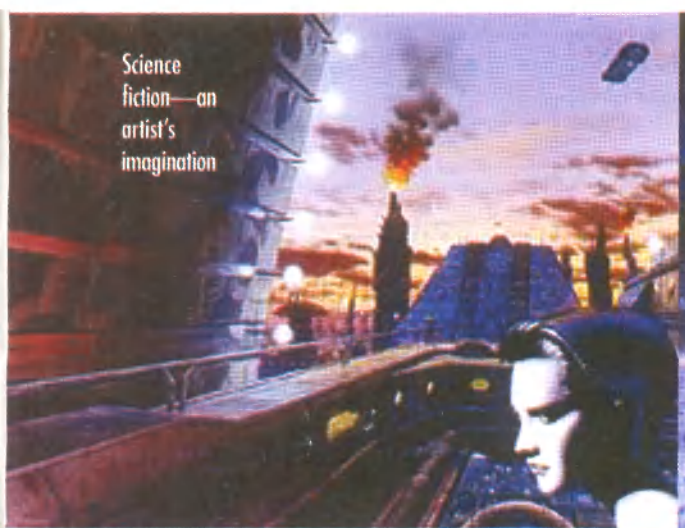
A Brief History

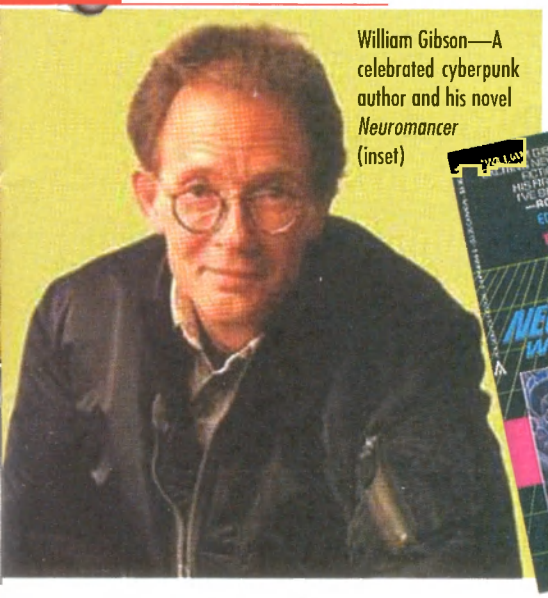
Edgar Allan Poe (19 January 1809–7 October 1849) is often credited along with Jules Verne and H.G. Wells as being one of the founders of modern science fiction. Poe's story *The Balloon Hoax* was an instant hit and perhaps inspired many later stories written on man's victory over the moon. But the majority opinion supports *Frankenstein* (1818) by Mary Wollstonecraft Shelly as being the first modern work of science fiction.

But the author who started writing science fiction the way we know it today is undoubtedly Jules Verne. His most famous novels are *From the Earth to the Moon* (1873) and *Journey to the Centre of the Earth* (1864). Later Wells's *The War of the*

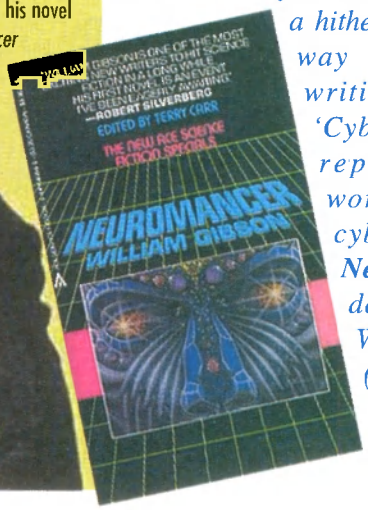
A scene from the movie *Starship Troopers* based on the novel of the same name by Robert Heinlein







William Gibson—A celebrated cyberpunk author and his novel *Neuromancer* (inset)



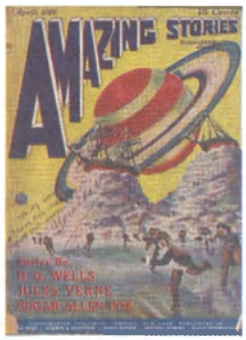
Computers were new themes in science fiction resulting into a hitherto unfamiliar way of literary writing termed 'Cyberpunk'. The representative work of cyberpunk was ***Neuromancer*** *a debut novel by William Gibson (17 March 1948-).*

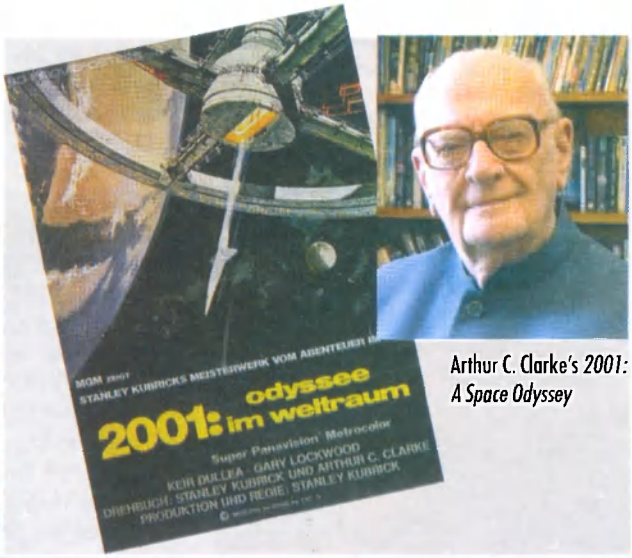
Worlds (1898) and *The Time Machine: An invention* (1895) attracted wide readership. The *Time Machine* talked of time travel far into the future being possible. The protagonist – the time traveler – returns and describes how evolution has made human beings split up into two races of gullible Eloise and the disgusting Morlocks.

In 1926, science fiction magazine *Amazing Stories* appeared and the editor was the journalist and publisher Hugo Gernsback (16 August 1884–19 August 1967), who labeled those stories under "scientification". The year 1937 witnessed another great editor of science fiction, John W. Campbell Jr. (8 June 1910-11 July 1971) who started publication of *Astounding Science Fiction* and published stories of such writers as Isaac Asimov, Arthur C. Clarke, and Robert A. Heinlein.

It was during this time that science fiction began to gain status as serious fiction. Campbell encouraged his authors to write in a realistic way about the possible effects of technology on people and society. He wanted them to be critical about science and write about what could happen if something went wrong. The quality of the stories improved and *Astounding Stories* became more realistic rather than imaginative. In between, during the period 1926-1950, science fiction was published mostly in American and British magazines.

In the years that followed, science fiction became a subculture with authors, editors, and fans. Some more magazines were started notably *Galaxy* (1950) and *The Magazine of Fantasy and Science Fiction* (1949). When nuclear bombs were dropped in Nagasaki and Hiroshima exactly in a manner that science fiction writers had predicted, the genre got more promotion and found many new readers.





Arthur C. Clarke's *2001: A Space Odyssey*

ALL TIME GREAT SF MOVIES!

Outbreak
Strange Days
Twelve Monkeys
Water World
Independence Day
Solaris
Mars Attacks!
Contact
The Fifth Element
Gattaca
Men in Black
Starship Troopers
Armageddon
Dark City
The Truman Show
The Matrix (and its two sequels)
Star Wars
The Cell
X Men and its sequels
A.I.: Artificial Intelligence
Minority Report
Terminator and its sequels
Eternal Sunshine of the Spotless Mind
Children of Men
Terminator Salvations
Transformer
Indiana Jones
The Day After Tomorrow
Crystal Zone
District 9
Avatar

SOME INDIAN SF MOVIES ...

Vahan ke Log
Mr. India
Koi Mil Gaya
Love Story 2050
Krish
Endhiran (Robot)

Science fiction began to be recognized as serious literature as readers were convinced that this new branch of literature could really predict the future.

Hard vs. Soft Science Fiction

Science fiction is often categorized under hard and soft forms of science fiction writing. The term hard science fiction is reserved for stories that are built on science without any deviation from known facts and where explanations are given in a reliable way rather than in an imaginative manner. Here technology plays a major part.

Artists' imaginations (above)

A scene from the movie *Avataar (left)*

Isaac Asimov—one of the most famous science fiction writers—signing autographs (below left)

Brian Aldiss—A new wave representative (below)

In soft science fiction, the stories are built on human psychology and emotions. The new wave of science fiction writing is usually soft science fiction, while cyberpunk, which evolved out of the new wave, is in something of a shadow land between hard and soft science fiction. Some critics say that most of the stories written by Arthur C. Clarke are hard science fiction while those by Isaac Asimov are soft science fiction involving social angles and human values.

The Golden Age

The enormous growth of the genre lead to the Golden Age of science fiction when many big authors and novels appeared on the scene: A.E. Van Vogt (26 April 1912 – 26 January 2000) with *Slan* (1940); Isaac Asimov with *Foundation* (1951); Robert A. Heinlein with *Starship Troopers* (1959) and *Stranger in a Strange Land* (1961), and Theodore Sturgeon (26 February 1918-8 May 1985) with *More than Human* (1953).

Often science fiction writers have been known to possess the predictive talent to foresee the future. Jules Verne (8 February 1828–24 March 1905), the celebrated French novelist, had such a prophetic vision and predicted well in advance man's landing on the moon.

Science fiction is often categorized under hard and soft forms of science fiction writing. The term hard science fiction is reserved for stories that are built on science without any deviation from known facts and where explanations are given in a reliable way rather than in an imaginative manner.

Philip K. Dick's (16 December 1928–2 March 1982) most famous title *Do Android Dream of Electric Sheep* (1968) on which a movie was made in 1982 named "Blade Runner" also appeared. In the 50s of the last century, Arthur C. Clarke's *2001: A Space Odyssey* (1968), Fredric Pohl and Kurt Vonnegut's *The Sirens of Titan* (1959) appeared and were considered to be the part of the same Golden Age.

Sometime later, a 'new wave' in science fiction writing appeared on the horizon and focused on the psychological aspects rather than technology oriented "hard science fiction". Important ingredients of the new wave were drugs, overpopulation, disasters, and sex. This new trend was represented by famous science fiction authors like Brian Aldiss (18 August 1925-) and J.G. Ballard (15 November 1930–19 April 2009).

With the advent of computers there were new themes in science fiction resulting into a hitherto unfamiliar way of literary writing termed 'Cyberpunk'. This was acknowledged very soon as a subgenre of science fiction writing. The representative work of cyberpunk was *Neuromancer* a debut novel by William Gibson (17 March 1948-). In cyberpunk, stories usually take place in the fantastic virtual worlds created through Internet that are still not affected by air pollution and decay. Popular movies in the subgenre of cyberpunk were "Blade Runner" (1982), "Videodrome" (1983) etc.

Popular Major Themes

Major themes of science fiction that continue to grab attention of audiences worldwide include space travels (viz., "Star Wars" and "Star Trek"), time travel (viz., "Back to the Future"), psychological or biological changes in man (viz., "The Incredible Hulk"), supernatural characters (viz., Superman, Spiderman, Batman), alternate universe (viz., "Star Wars") etc. Apocalyptic science fiction, which incorporates end of world stories, alien invasions, utopias and dystopias, alternate history/universe, are some other most popular themes.

Terms like Robots, Androids, Cyborgs, Clones, Cyberpunk/Virtual Reality, Pantropy, Genetic engineering, and nanotechnology etc are very familiar to these themes. Cyberpunk is the fairly recent genre of dystopic (opposite, utopian) near-future world where there is global connectivity and communication through the web, bio/techno enhancements, and a mood of alienation, resistance, often sex and graphic violence. Virtual reality, holographic simulations, artificial intelligence also make frequent appearances in these themes.

Popular science fiction themes in India include space travels, environmental imbalance, population explosion, material transfer, clones, memory transfer, planetary travels, innovations in medicine etc. Since science fiction is imaginatively a very fertile field science fiction writers are trying on many themes of their choice.

Dr Arvind Mishra is Secretary, Indian Science Fiction Writers' Association, 16 Cotton Mill Colony, Chowkaghat, Varanasi–221001, U.P.; Email: drarvind3@gmail.com; Blog: http://indiascifiarvind.blogspot.com/

THOSE FIRST INDIAN SF STORIES...

Perhaps the first true Hindi science fiction was a serial written during 1884-88 by Ambika Dutt Vyas entitled "The Strange Tale" (*Aaschary Vrittant*), which was published in *Peeyush Pravah*, a magazine published from Madhya Pradesh. Influenced perhaps by the adventure stories of Jules Verne, *Aaschary Vrittant* presented a very interesting, captivating saga of one Mr. Gopinath, the protagonist who took the breathtaking adventurous journey underneath the earth. Though influenced by western stuff the story was an original effort of science fiction writing in Hindi.

A notable Bengali science fiction was Jagadananada Roy's *Shukra Bhraman* (Travels to Venus), published in 1879. Another story that caught the attention of Indian science fiction fans was written by an icon in the Indian scientific world—J.C. Bose (30 November 1858–23 November 1937). He wrote "Absconded Tempest" (*Palatak Toofan*) in 1896, which narrates a thrilling story of how a turbulent sea was calmed with as ordinary as a drop of oil. The story bears a strange semblance to the 'chaos theory' propounded much later.

In Marathi, science fiction writing started late around 1910 with the publication of a translation of Verne's *Men in the Moon* serialized in a magazine named *Kerala Kokil* printed and published in Cochin. In yet another prominent Indian language, Tamil, the history of science fiction writing could be traced back to 1959, of course a very late beginning, in the writings of a great poet Mahakavi C. Subramania Bhartiya whose story entitled, *Kakkai Parliament* (Parliament of the Crows) is said to have some science fiction elements.

Science fiction writing in many other Indian languages seems to have been initiated much later. In Malayalam for instance, science fiction writing appears to have been initiated in 1950, with the initiative taken by the Kerala Sastra Sahitya Parishad—a most respected autonomous body devoted to science popularization in the country.

Similarly, Assamese language with its very laudable role and history in science fiction writings stepped into the arena of science fiction writing in the late 1930's. In Kannada, science fiction writing began in the 1940's with the advent of Dr. Sadanand Nayak with his famous love story employing a plot on heart transplant.

K. SMILES MASCARENHAS

ARTHUR C. CLARKE

Father of Satellite Communication

Sir Arthur C. Clarke, one of the greatest science fiction writers, will continue to shine like a bright star among the scientific greats of our time for years to come.

"Prediction is very difficult, especially if it's about the future."
— Niels Bohr

WHEN we see Wimbledon live, or the opening ceremony of the Olympics, via satellite, we seldom remember the person who first suggested that satellites could be used for communication purposes. Even when that person entered the Glorious Abode on 19 March 2008, few TV channels remembered him with gratitude. Even Science Fiction buffs who read his novels avidly must have failed to notice the demise of a great Scientific Prophet—Sir Arthur C. Clarke who predicted not only communication through geostationary satellites, but also advances in computer technology.

Clarke was born in Minehead, Somerset, England on the 16th of December 1917. As a boy, astronomy attracted his attention and he spent hours gazing at the night sky with his simple binoculars. At the age of thirteen, he built his own optical telescope and used it for serious observations. He also enjoyed reading science fiction, something that inspired him to write hundreds of science fiction novels later. Even at a tender age, he built transmitters and crystal radio receivers. He studied up to secondary school and since he was unable to afford a university education, got a job as an auditor in the pensions section of the Board of Education.

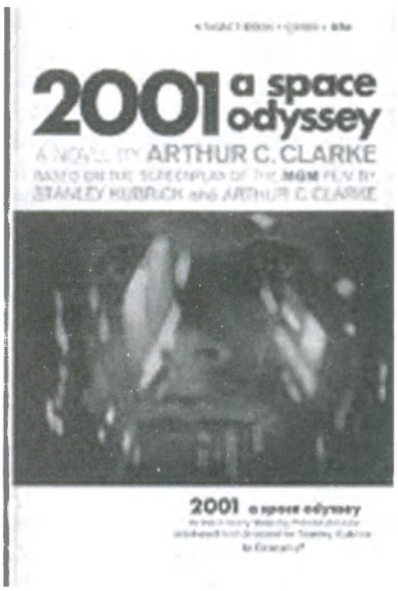
His avid interest in reading technical books, however, made him a scholar in science without a degree. During the Second World War he served in the Royal Air Force as a radar specialist and was involved in the early warning radar defense system, which contributed to the RAF's success during the Battle of Britain. He later wrote the semi autobiographical novel *Glide Path*, based on his wartime experiences. After the war he earned a B.Sc. degree (with honours) in mathematics and physics at King's College London.

In 1945, he proposed the concept of setting up three geostationary satellites that will help the world to communicate. Since the first man-made satellite *Sputnik I* was launched only on 4 October 1957, this must have been a daring prediction of his time.

A geostationary satellite is a satellite that has its revolution period equal to the earth's rotation period. When viewed from any geographical point, it will appear to be stationary above it. To satisfy this condition, the satellite has to orbit the earth at a height of 36, 000 km above the equator. Technologically, it would not have appeared feasible at that time. An orbit of 36,000 km above the equator is officially recognized by the International Astronomical Union (IAU) as a "Clarke Orbit", in his honour. The concept was published in the "Wireless World" magazine in October 1945. Clarke would have made billions if he had patented his idea. But like the great Marie Curie, who refused to patent her discovery of Radium, Clarke's only intention was to make the world a better place to live.

Clarke also wrote a number of non-fiction books describing space flight and space colonies. The most notable of these may be *The Exploration of Space* (1951) and *The Promise of Space* (1968).

Even though he was 90 years old, he was active till the end. Only a few days before his death, he reviewed the final manuscript of his latest science fiction novel, The Last Theorem, co-written with the American author Frederik Pohl.



In 1948, he wrote the novel *The Sentinel* for a BBC competition. Though the story was rejected it changed the course of Clarke's career. The story formed the basis for his masterpiece, *A Space Odyssey*. Strangely, the novel was published after the release of the film *2001: A Space Odyssey* that was partly based on it. The tagline of the film was "Let the Awe and Mystery of a Journey Unlike Any Other Begin". The film was released in 1968, and it was the combined effort of Clarke and its director Stanley Kubrick.

In many ways it differed from the novel on which it was based, but both the film and the novel were instant successes. The timing of its release was perfect, since it was during the intense preparation of NASA's effort to put man on Moon. When the film was released in India, just a few months after Neil Armstrong walked on the Moon, there was a heavy rush to see it initially. The film had some mystical element attached to it and some philosophical implications embedded that was not appreciated by the Indian audience. In no time, its popularity waned. Even in 1968, it appeared so improbable that we would ever build a computer that would pick a quarrel with us! It appeared extremely farfetched that it would happen in the year 2001! The film, however, won an Oscar for Special Visual Effects and was nominated for two more awards.

In a lighter sense, Clarke proposed the following three "laws" of prediction (in the essay "Hazards of Prophecy: The Failure of Imagination") :

1. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.

2. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.

3. Any sufficiently advanced technology is indistinguishable from magic.

He later commented that he could have proposed more, but since three laws of motion were sufficient for Newton, his three laws should serve equally well! However, the temptation to add a fourth law was so irresistible that he stated: "For every expert there is an equal and opposite expert."

As a boy, astronomy attracted Arthur's attention and he spent hours gazing at the night sky with his simple binoculars. At the age of thirteen, he built his own optical telescope and used it for serious observations.

Clarke lived in Sri Lanka from 1956 until his death in March 2008, having emigrated there when it was still called Ceylon, first in Unawatuna on the south coast, and then in Colombo. He held citizenship of both the UK and Sri Lanka. He was an avid scuba diver and a member of the Underwater Explorer's club. Living in Sri Lanka afforded him the opportunity to visit the ocean year-round. It also inspired the locale for his novel *The Fountains of Paradise* in which he describes a space elevator. This, he believed, ultimately will be his legacy, once space elevators make space shuttles obsolete.

His many predictions culminated in 1958 when he began a series of essays in various magazines that eventually became "Profiles of the Future" published in book form in 1962. A timetable up to the year 2100 describes inventions and ideas including such things as a "global library" for 2005.

In the 1980s Clarke became well known to many for his television programmes *Arthur C. Clarke's Mysterious World* and *Arthur C. Clarke's World of Strange Powers*. In 1986, he was named a Grand Master by the Science Fiction Writers of America.

In 1988 he was diagnosed with post-polio syndrome, having originally contracted polio in 1959, and needed to use a wheelchair most of the time thereafter.

In September 2007, he provided a video greeting for NASA's Cossini probe's flyby of Iopetus (which plays an important role in *2001: A Space Odyssey*).

In the 1989 Queen's Birthday Honours, Clarke was appointed Commander of the Order of the British Empire (CBE) "for services to British cultural interests in Sri Lanka". The same year he became the first Chancellor of the International Space University, serving from 1989 to 2004. He also served as Chancellor of Moratuwa University in Sri Lanka from 1979 to 2002.

Sir Clarke passed away at Colombo's Apollo Hospital on 19 March 2008 after a brief illness. Even though he was 90 years old, he was active till the end. Only a few days before his death, he reviewed the final manuscript of his latest science fiction novel, *The Last Theorem*, co-written with the American author Frederik Pohl.

In the foreword of his novel, *2001: A Space Odyssey*, Clarke wrote:

"Behind every man now alive stand thirty ghosts, for that is the ratio by which the dead outnumber the living. Since the dawn of time, roughly a hundred billion human beings have walked the planet Earth. ...Now this is an interesting number, for by a curious coincidence there are approximately a hundred billion stars in our local universe, the Milky Way. So for every man who has ever lived, in this Galaxy, there shines a star."

May be Clarke was not serious about the statement that he made. But we can be sure that he will continue to shine like a bright star among the scientific greats of our time for years to come!

Prof. K. Smiles Mascarenhas, Dean (Academic Affairs), Coimbatore Institute of Engineering and Technology, Narasipuram Post, Coimbatore–641109. A product of the Loyola College, Chennai and the Madras Institute of Technology, Chennai, he worked in the field of Radio Astronomy for about 17 years, and has been teaching for the past 16 years. He can be contacted at smiles51@rediffmail.com.

Fuel From Water & Carbon Dioxide Using Sunlight

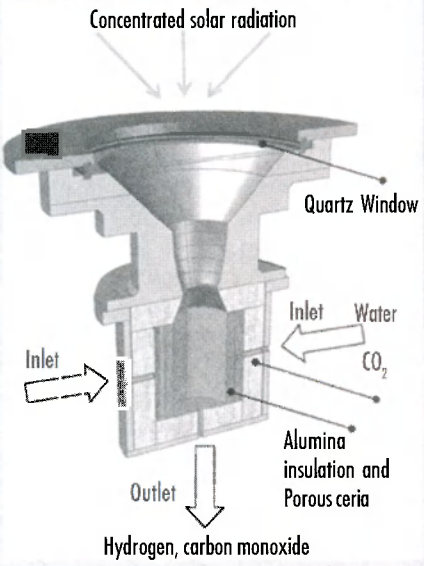
SCIENTISTS from the California Institute of Technology (CalTech), based at Pasadena, California, USA have come up with a way to convert water and carbon dioxide into fuel using sunlight and an oxide of a naturally occurring rare earth metal—cerium—as a catalyst.

Professor Sossina Haile and her team working at Caltech have developed and demonstrated a prototype device capable of imitating the way in which plants turn sunlight into carbohydrates – photosynthesis.

Photosynthesis is vital for life on Earth. As well as maintaining the normal level of oxygen in the atmosphere, nearly all life either depends on it directly or indirectly as a source of energy. Photosynthesis is also the source of carbon in all the organic compounds.

The device uses the Sun's rays and cerium oxide to break down carbon dioxide and water in the air into a gas mixture of carbon monoxide and hydrogen gases known as "synthesis gas," or "syngas," as it is also commonly called. It can then be converted into liquid fuels through well-established processes.

The newly developed device uses a quartz window and cavity to concentrate sunlight into a cylinder lined with cerium oxide – a refractory material more or less like a rock. But it has the incredible ability to release oxygen when heated to about 1,600°C and absorb it back when cooled. (The heat required in the process comes from sunlight).



It can lose one-in-eight of its oxygen molecules when heated and absorb them back (not from the oxygen released by it but from water molecules present in the form of steam or from carbon dioxide gas) while cooling to about 800°C, thus creating hydrogen and carbon monoxide in the process.

The development of the device is significant because while hydrogen is particularly viable as an alternative transport fuel, its production by currently used technology is inefficient.

However, the device will need to be considerably refined. Solar-to-fuel efficiencies of 0.7 to 0.8% were achieved and shown to be largely limited by the size of the device, rather than by chemistry.

Nevertheless, the main components of the device – quartz and cerium oxide – are available in abundance. There is nothing cost intensive in the set-up. And there is plenty of cerium [oxide] available on Earth for this technology to make a major contribution to global fuel supplies.

In tests, the device was cycled up to 1, 6000°C then cooled down to 800°C more than 500 times without damaging the cerium oxide catalyst.

A device big enough to fit on average house rooftop could be capable of generating about 12 litres of fuel per day which ought to be more than sufficient to cover the transport needs of the average household.

However, storage – given the volatility of hydrogen – may be an important issue. As of today there is no economic way of storing and transporting hydrogen as a gas.

Shortly after William Chueh, a graduate student, joined Prof Haile's laboratory he and Sossina started talking about whether cerium oxide could also play a role in using the heat of the sun to convert a cocktail – carbon dioxide and water in the form of steam – into "syngas".

Currently the team is working on experiments to demonstrate that this is not just a laboratory curiosity, but also a solution that could potentially work on a larger scale.

Contributed by G. V. Joshi, E/2-11 Girijashankar Vihar, Karvenagar, Pune, 411052

Guaiacum – A Broad Spectrum Remedy

POCKWOOD, a plant exotic to India, is reported to find use as an anti-hypertensive, antiseptic, mild laxative and an expectorant. It is also used for increasing body heat and circulation, as a blood purifier and antioxidant.

Botanically known as *Guaiacum officinale. L*, pockwood belongs to the family Zygophyllaceae. It is a native of West Indian Islands and also found in Mexico, Central America, North Coast of South America.

The tree grows to a height of 9-12 m. The stem is generally crooked and the wood intensely hard, leaf is compound with 2 or 3 pairs of smooth leaflets.

Two-in-one Plants

GENERATING bio-energy from the biomass produced by phytoremediator plants after they have absorbed enough pollutants is a new area of research. There are many potential economic opportunities for biomass associated with phytoremediation, including bio-energy and traditional industrial products such as solid wood products and reconstituted products.

Phytoremediation is the use of plants and plant processes to remove, degrade or render harmless hazardous materials present in the soil or water. It is a low cost, solar energy driven clean up technique and used for the removal of pollutants from both soil and water. Some

Beautiful blue flowers at the end of the branches grow in great profusion and cover almost the entire tree for a long time.

The fruit appears as small, round, compressed, yellow capsules. Each capsule has five cells with a single seed in each. The name lignum-vitae (wood of life) is attributed to the supposition that the wood was used for healing most serious diseases of mankind like secondary syphilis etc. in the sixteenth century. However, later the resin obtained from wood and bark was used in powder, pill and tincture form.

The resin is obtained by raising one end of the log and firing it. This melts the resin, which runs out in the other end and is collected in vessels. It is in the form of round or ovoid tears and is stored in large blocks that can be broken easily for use. The powder is grey and is stored in dark colored bottles as exposure to the light and air soon turns to green.

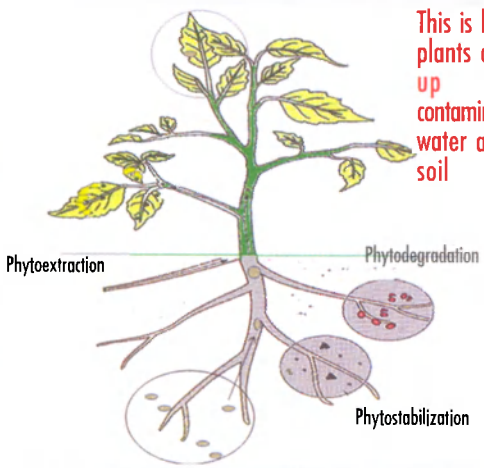
The chief constituents of the resin are resin acid, a- and a-guaiaconic acids (about 70 %), guaiaretic acid (about 11 %), the resin also contains guaiac-a-resin (15 %) and small quantities of guaiac-yellow, vanillin, and guaiacsaponin. The resin in alcoholic solution is used to detect occult blood in faeces; it is used externally to relieve toothache and joint pain; internally in rheumatoid arthritis, rheumatic arthritis and in gout.

It is also used as an anti-hypertensive. When a decoction of the resin is taken hot and the body kept warm, it promotes perspiration and when taken cold and body kept cold, it acts as a diuretic.

Contributed by Dr. Hafeezullah Baig, Assistant Director (H), Drug Standardisation Unit (H), Central Council for Research in Homoeopathy, O.U.B No.32, Osmania University, Hyderabad-500007; Email: drhafeezullahbaig@gmail.com
Dr. Suryanarayana.Y, Senior Research Fellow, Drug Standardisation Unit (H), Central Council for Research in Homoeopathy, O.U.B No.32, Osmania University, Hyderabad-500007; Email: drsuryamd@gmail.com

ornamental trees that can tolerate pollution have been screened and recommended for planting along the roads like Kanji (*Pongamia pinnata*), Ratan Jote (*Jatropha curcus*), Ficus (*Ficus religiosa*), Bergad (*Ficus benghalensis*), Neem (*Azadirachta indica*), Arjun (*Terminalia arjuna*), *Techtona grandis* etc. Some lower plants as well as algae are also using as a source of bioenergy.

These trees are also used as green belts for minimizing air pollution by filtering, absorbing and adsorbing pollutants in an effective manner. Phytoremediation can be used to cleanup metals, pesticides, solvents, explosives, crude oil, polyaromatic hydrocarbon and land fill leachates.



The techniques involved in phytoremediation are phytoextraction (the roots of plants absorb the contaminants from the soil and translocate them to the above ground green parts of the plants like shoots and leaves); rhizofiltration (the plants that can absorb contaminants are transplanted to metal polluted waters where they absorb and concentrate the metals in their roots and shoots); phytostabilization (plants are used to immobilize or stabilize waste materials, which suppresses the migration of contaminants in to the ground water) and phytovolatization (some toxic metals like arsenic, mercury and selenium are absorbed by plants from the soil and released in to the atmosphere as non toxic or less toxic form).

There are many fast growing and high biomass producing plants like *Ricinus communis* (Castor) and *Jatropha curcas* that have very good potential to accumulate non-degradable and very hazardous heavy metals. Growing such plants will not only make heavy metal contaminated soils productive but will also help to generate bio-fuels that can be used for automobiles and industries. Utilization of biomass residues generated from the phytoremediation, which would have otherwise been dumped in landfills, also greatly reduces greenhouse gas emissions by preventing the formation of methane.

Contributed by Kuldeep Bauddh, Sanjeev Kumar and Surendra Vikram Ghavri, Research Scholars, Department of Environmental Science, Babasaheb Bhimrao Ambedkar University, Lucknow-25. E-mail:

EFFORTS TO CONSERVE *MUCUNA PRURIENS* AT TBGRI

MUCUNA pruriens (L.) DC. (Fabaceae), known as 'Naikorana' in Malayalam, is a climbing shrub of pantropical distribution. The seeds of the species are a source of the bioactive compound L-Dopa, which is the major constituent of allopathic medicines used for curing Parkinson's disease.

This species has four varieties viz., *Mucuna pruriens var. pruriens* (L.) DC., var. *hirsuta* (Wight & Arnold) Wilmot-Dear, var. *thekkadiensis* (Thoth. & Ravi) and var. *utilis* (Wall ex Wight) Bak ex Burck. The var. *pruriens* is pantropical in distribution and is found in the semi-evergreen forests and fringes of farmlands, whereas the var. *hirsuta* and var. *thekkadiensis* are endemic to the southern Western Ghats and are seen in evergreen forests. The var. *utilis* is reported hitherto only from cultivation.

The plants of the species growing in the wild are often considered a menace by people living nearby due to the itching property of its hairs. As a result, mature plants of the species are destroyed from the vicinity of human dwellings and from the periphery of forest areas. Depletion of populations of the species is leading to gene-erosion (loss of genotypes) and elimination of many potential genotypes. Gene erosion occurs much earlier than total extinction of a species. Therefore, loss of genotypes is a matter of concern with respect to conservation, cultivation and utilization of *Mucuna pruriens*.

Identification, characterization and documentation of genotypes of a species are the fundamental steps to be attended for mitigating gene-erosion. As a part of conservation and utilization oriented studies of *M. pruriens* undertaken at TBGRI, field explorations were carried out in different parts of Kerala. Accessions of the species representing different populations were collected along with their field data and a field gene bank was developed.

The morphological characterization of the accessions based on 30 qualitative and 55 quantitative characters revealed that many intraspecific forms of the species other than the already known four taxonomic varieties occur in Kerala. Variations with respect to leaves, inflorescence, flowers, pods and seeds were well evident with respect to the accessions of the species. Replicated field trials (RBD) of the 30 accessions of the species were undertaken to evaluate its morphological/agronomical characters.

In order to identify elite chemotypes with respect to L-dopa content, chemical analysis of the seeds of the accessions are being undertaken in collaboration with phytochemistry and phytopharmacology division of the Institute. Thus, the study on intraspecific variation of *M. pruriens* has provided new insights leading to identification of its potential genotypes and its unique characters, which in turn can augment conservation, cultivation, utilization as well as genetic improvement of the crop.

Contributed by Ms P. Haridas, Junior Research Fellow, Plant Genetic Resource Division, Tropical Botanic Garden & Research Institute, Palode, Trivandrum, Kerala–695562

NEWS BRIEFS

■ Scientists have discovered a rogue gene involved in the spread of cancer in the body. By blocking the gene, they believe, cancer could be stopped in its tracks. The culprit gene — known as WWP2 — is an enzymic bonding agent found inside cancer cells. It attacks and breaks down a natural inhibitor in the body that normally prevents cancer cells spreading. By blocking WWP2, levels of the natural inhibitor are boosted and the cancer cells remain dormant.

■ It's a common assumption that animal migration can transport pathogens long distances increasing disease risks to humans. Animal migrations could actually help reduce the spread and prevalence of disease and may even promote the evolution of less-virulent disease strains. Migration allows the hosts to periodically escape parasite-laden habitats. The migrating animals find a largely disease-free habitat when they return. Long migratory journeys can also weed infected animals from the population.

■ Replaying memories while people are awake leaves their memories subject to tinkering. But reactivating memories during sleep protects them from interference. The finding shows that the brain handles memories differently during sleep than while awake. Armed with this new knowledge, the therapists may be able to destabilize traumatic memories and overwrite the bad memories with good ones, then solidify the new memory with a nap.

■ An important portion of Himalaya's glacier cover is currently stable and, thanks to an insulating layer of debris, may be even growing, a new study finds. That's not to imply that water reservoirs are not under stress. Throughout most Himalayan ranges, roughly 65 per cent of the studied glaciers were shrinking. But in Karakoram, 58 per cent of studied glaciers were stable or slowly expanding up to 12 meters per year.

■ Young kids lacking self-management skills are more likely to be big-time losers in the game of life, a new study finds. Low levels of conscientiousness, perseverance and other elements of self-control in youngsters as young as age 3 herald high rates of physical health problems, substance abuse, financial woes and criminal arrests. For as-yet-unknown reasons, 7 per cent of youngsters in the long-term study developed notably better self-control as they got older. They displayed better health and had fewer criminal run-ins.

■ Genetic sequencing alone is not enough to understand human disease. Researchers have shown that functional tests are absolutely necessary to understand the biological relevance of the results of sequencing studies as they relate to disease, using a suite of diseases known as the ciliopathies that can cause patients to have many different traits. The study shows how genetic variations can cause ciliopathies and also interact with other disease-causing genes to yield very different sets of patient problems.

FEATURE ARTICLE

Is There Life Beyond Earth?

Discovery of river channels on Mars, possible fossil evidence of ancient microorganisms in a meteorite from Mars, hints of water ice on the Moon and Mercury, oceans on Europa and Enceladus, organic materials and an atmosphere on Titan, and cryovolcanism seen on Enceladus and Triton suggest that the solar system might not be as inhospitable to the development of life as was believed immediately following the results of the Viking Landers.

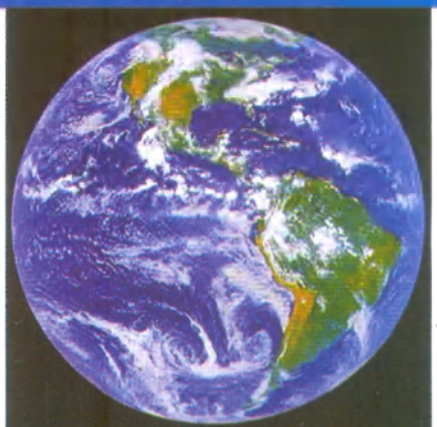
N. RAMDAS IYER

THE Earth looks like a big, beautiful blue marble from space. Our home planet is certainly one of the most beautiful planets in the solar system, and it is also the only planet we know that supports life in any form. Other planets in our solar system may turn out to have life in some form, but, at best, it would probably be very tiny forms of life, such as microbes.

The Earth is unique in our Solar System most notably because it harbours complex, intelligent life that has survived and evolved through 3.9 billion years of the planet's 4.5 billion year history. There are a number of conditions that make life possible on Earth. Among them are:

- Liquid water near the surface;
- A level of incoming radiation from space, filtered through our atmosphere, that is neither too much nor too little;
- A stable planetary orbit around the Sun;
- The presence of a gaseous atmosphere and liquid water ocean;
- Enough internal heat from the planet's molten core to allow plate tectonics (which are important for maintaining the balance of the carbon cycle);
- Having Jupiter as a neighbour that protects us from comets and asteroids;
- The presence of a large moon that stabilizes tilt (keeping the seasons mild) and the tides;
- The relative absence of impacts from asteroids or other matter flying through space, after an initial bombardment period early in the Earth's history;
- Our current position relative to the Sun, which provides us heat and energy, and
- The evolution of the process of photosynthesis within microbial life forms at a certain point in Earth's history, which in turn enriched the atmosphere with oxygen, enabling life to evolve.

No other planet to our knowledge has this delicate balance of conditions, making Earth rare indeed. But each planet has it's own set of geochemical and atmospheric conditions that make it unique. Just because we don't see Earth-like conditions on other planets does not mean life, as we know it, cannot exist there. Understanding where life might have developed in the solar system requires comprehension of how life arose on Earth.



Life on Earth is based on complex organic molecules consisting of chains of carbon, hydrogen, nitrogen, and oxygen

Dust analyzers on spacecraft zooming past Halley's comet determined the chemical composition of dust particles emitted by the comet

Life on Earth

The earliest evidence of life on Earth is the presence of organic matter derived from biological processes recorded in rocks that are about 3.2 billion years old. Life may have developed very early in Earth's history. However, much of the fossil record of early life on the Earth has been erased by subsequent geophysical activity. Biologists have pieced together some of that early history by examining the remaining fossil record and by performing a series of laboratory experiments.

Life on Earth is based on complex organic molecules, consisting of chains of carbon, hydrogen, nitrogen, and oxygen. However, organic molecules can be produced by simple chemical reactions as well as by biological activity. Thus, to determine if a process is truly biological, rather than simply a chemical reaction, it is necessary to define the criteria for life. The ability of an organism to reproduce itself is considered to be an essential feature of life.

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are the organic molecules that control heredity in terrestrial life forms. Thus, DNA and RNA are considered essential for reproduction of life on Earth. These two nucleic acids are produced only with the help of certain proteins. A major focus of exobiology is to understand how DNA, RNA, and the proteins essential in their production originated.

A major breakthrough occurred in 1953, when Stanley Miller, a graduate student at University of Chicago, and his research supervisor, Professor Harold Urey, produced amino acids, the basic building blocks of proteins, in a sealed environment simulating conditions believed to be present on the early Earth. Miller and Urey continuously passed electrical sparks through a chamber filled with a gaseous mixture of methane, ammonia, and hydrogen (a composition believed to be similar to that of the early atmosphere of the Earth) and water vapour (representing the water contributed by the Earth's oceans).

After several days they extracted a mixture of organic molecules, including amino acids, from the bottom of the chamber. The Miller-Urey experiment suggested that lightning discharges throughout Earth's early atmosphere could have led to the formation of amino acids on the planet's surface. Other experiments demonstrated that bombardment of the gas mixture by high-energy particles, simulating cosmic rays, produced similar results.

These experiments suggest that three sufficient conditions must be met to produce amino acids: a supply of carbon-rich material must be present, liquid water must be available, and some energy source (electrical discharge, high-energy particles, or possibly heat and sunlight) is required.

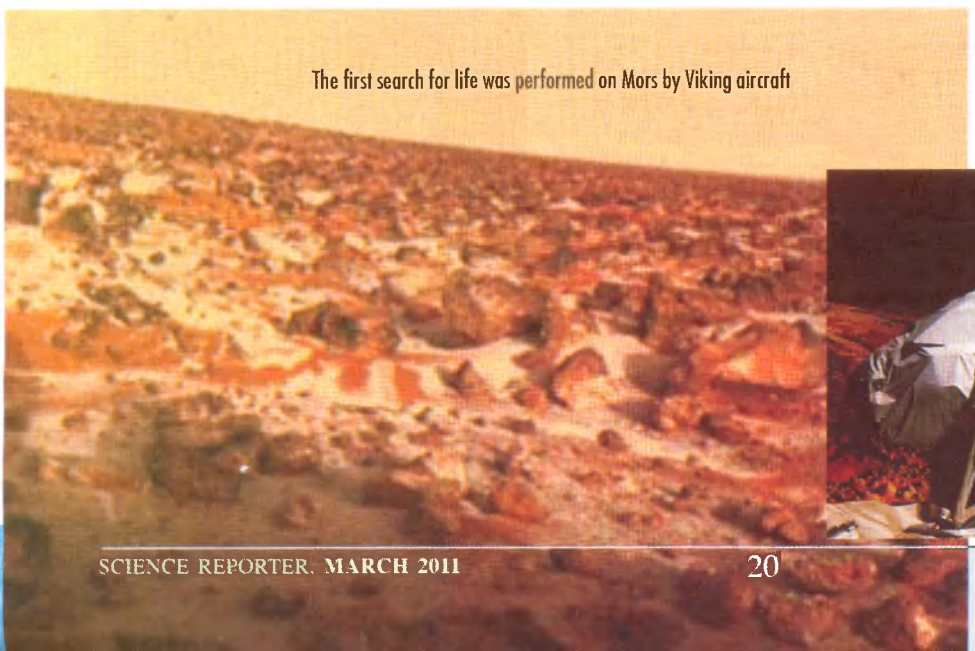
Ideal Extraterrestrial Conditions

Scientists have examined the planets and satellites of the solar system, searching for locations where all three conditions are met. Water may be the most critical restriction, since it remains a liquid only over a very narrow range of temperatures. The surfaces of Venus and Mercury are too hot for liquid water to be present.

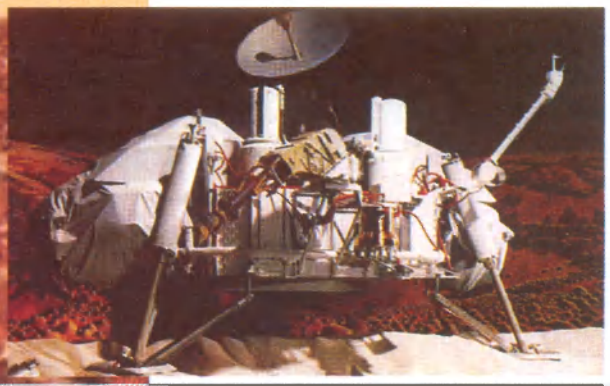
Jupiter, Saturn, Uranus, and Neptune are too cold to support liquid water. Thus, of these eight planets only Earth and Mars seem to be suitable candidates for life, because they are in the range of distances from the Sun such that they could support liquid water. Venus is within the Sun's habitable zone as well, but a runaway greenhouse effect of unknown origin has left it inhospitable to life as we understand and recognize it.

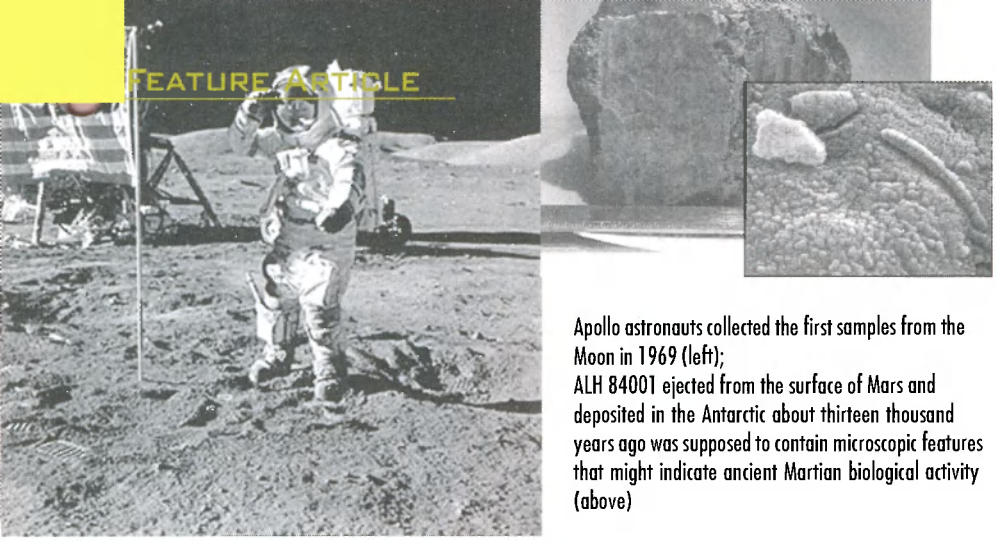
Where life is abundant, it can produce changes in the atmosphere of a planet, allowing astronomers to search for unusual signatures of biological activity. The present composition of the Earth's atmosphere, dominated by nitrogen and oxygen, is regulated by the life-cycle processes of respiration and photosynthesis of Earthly organisms. The atmosphere of Mars, on the other hand, is dominated by carbon dioxide, and it contains only a trace amount of oxygen. Thus, by the 1960's astronomers had observed that, at least in the present era, living organisms were not present in sufficient abundance to perturb the atmospheric chemistry of Mars.

The beginning of the space age made it possible to employ robotic spacecraft to perform direct measurements on the surface of some planets in the expanding search for evidence of life. The first search was performed on Mars by two Viking spacecraft, developed by the National Aeronautics and Space Administration (NASA), which landed safely in 1976. Each



The first search for life was performed on Mors by Viking aircraft





Apollo astronauts collected the first samples from the Moon in 1969 (left);
ALH 84001 ejected from the surface of Mars and deposited in the Antarctic about thirteen thousand years ago was supposed to contain microscopic features that might indicate ancient Martian biological activity (above)

Viking spacecraft was equipped with instruments designed to examine the soils of Mars for evidence of Earth-like life.

During the 1980s and 1990s, developments in terrestrial biology changed how exobiologists looked at the essential conditions for the development of life. Single-celled organisms called archaebacteria, which may have developed very early in Earth's history, were discovered. These archaebacteria live in oxygen-deprived places, such as the hot springs at Yellowstone National Park.

Archaebacteria take in carbon dioxide and give off methane, and they actually cannot thrive in the presence of oxygen. They have genetic material different from that of other terrestrial life forms, suggesting that they possibly evolved independently from the more common life forms very early in Earth's history before the current oxygen-rich atmosphere arose.

Other terrestrial microorganisms were discovered that live on sulphur from geothermal sources rather than by relying on the Sun to supply energy. The discovery of these unusual terrestrial life forms suggests that conditions required for development of the common forms of life on Earth may not be required for the development of all life. Thus, some planets and/or their satellites previously believed to be unsuitable for the development of life may be habitable by organisms rather different from the common life-forms on Earth. This complicates the search for extraterrestrial life, because many experiments, such as those conducted by the Viking spacecraft on Mars in 1976, look only for signatures specific to common terrestrial life.

In the late 1990s and throughout the first decade of the twenty-first century, extrasolar planets were increasingly detected. Although the majority of the first hundred or so worlds were hot Jupiters or at least bizarre large planets in systems not conducive to life as we understand it, in time it became increasingly clear that technology would shortly be capable of picking up Earth-sized planets. A space-based observatory named Kepler was readied for launch in late 2008. One of its planned objectives was to expand the list of extrasolar planets tremendously and perhaps detect the first Earth-like planets.

Three things must be noted, however. One, there are scientists who dispute the Milier-Urey experiment's validity in terms of the suggestion that production of organic materials in this fashion necessarily leads to the development of life. Two, there remain—even three decades after the Viking biological experiment produced data suggestive of superoxide reactions in the Martian soil rather than a biological metabolism—many scientists who believe that the Viking results were misinterpreted. Perhaps the dismissal of a biological result was premature. Third, many astrobiologists insist that if one restricts one's search to life as we know it based on DNA, one severely limits the possibility for a successful result. Some even question the need for water as a "universal" solvent for life. Organisms using a different solvent would be vastly different.

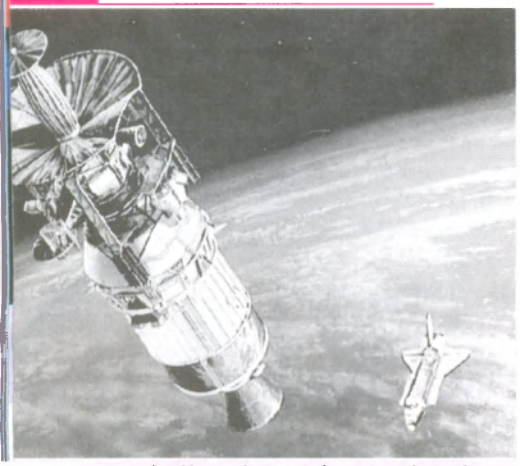
One focus of the search for life is to identify the carbon-rich compounds available for life's development. Impacts of meteorites, asteroids, and comets are believed to have contributed a carbon-rich layer to the Earth's early surface and other planets and their satellites. One particularly carbon-rich meteorite, called Murchison, fell in Australia in 1969. Detailed studies of Murchison established that it contains numerous organic compounds, including amino acids.

In 1986 five spacecraft, two launched by the Soviet Union, two by Japan, and one by the European Space Agency, flew past Halley's comet. Dust analyzers on some of these spacecraft determined the chemical composition of individual dust particles emitted by the comet. These instruments detected a large number of carbon rich particles, many of which also contained hydrogen, suggesting the presence of organic molecules in the dust. However, detailed analysis of organic molecules requires sophisticated scientific instruments too large and complicated to be flown on those spacecraft.

NASA launched a spacecraft called Stardust to fly to Comet Wild 2 to collect dust emitted by that comet. It successfully returned samples to Earth in 2006. Laboratory study of the dust established the abundances and types of organic compounds present in Wild 2.

The second focus of the search for life is to perform direct tests for the presence of biological activity on other planets or satellites. Apollo astronauts collected the first samples from the Moon in 1969. When they returned to Earth, the astronauts, their spacecraft, and their prized lunar rocks were subjected to a twenty-one-day quarantine during which scientists searched for living microorganisms that might be hazardous to life on Earth. Fragments from lunar rocks were crushed and placed in a standard culture medium, a nutrient-rich soup that promotes the growth of microorganisms. Microscopic examination of these samples showed no evidence of living microorganisms. More detailed studies of the lunar rocks have shown no fossil evidence of life forms that might once have developed on the Moon but are now extinct. Examination of lunar samples revealed them to be exceptionally dry, with none showing any evidence of liquid water. The absence of liquid water was taken to indicate that the Moon was always a lifeless body.

Initial experiments in the search for life on another planet were conducted in 1976 by the two Viking spacecraft that landed on Mars. Each Viking carried four instruments to examine the soil samples for evidence of such basic life-cycle processes as respiration or photosynthesis. The Gas Exchange Experiment deposited samples of Martian soil in a chamber containing a culture medium. This apparatus monitored the composition of gas within its chamber, looking for



One of Galileo's orbits around Jupiter took it within 363 miles of Europa's surface, allowing its cameras to photograph objects as small as 75 feet across

changes in the abundance of carbon dioxide, oxygen, or hydrogen that would signal metabolic activity by microorganisms in the soil.

In a second experiment, the Labelled Release Experiment, radioactive carbon atoms were incorporated into the culture medium. A detector looked for the appearance of radioactive carbon in released gas, signalling that the addition of Martian soil to the nutrient had resulted in a reaction of biological origin. Both experiments produced positive results, but the effects were much more dramatic than the scientists had expected. These positive results were eventually explained as chemical reactions initiated because of the highly reactive nature of the surface materials on Mars resulting from their exposure to ultraviolet light from the Sun, a superoxide chemical reaction.

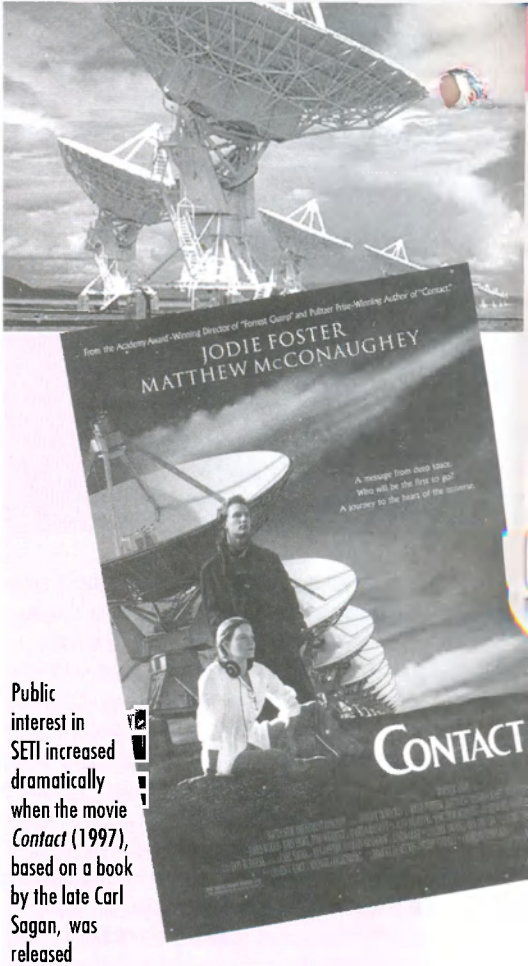
The Pyrolitic Release Experiment provided an opportunity to test that explanation. It was also a labelled release experiment, but this apparatus had the additional capability of heating soil samples between experiments. Scientists heated soil to 548 Kelvin, well above the temperature expected to kill any microorganisms present in the soil. Even then the Pyrolitic Release Experiment yielded positive results, suggesting that the release was produced by a chemical reaction involving superoxides rather than a biological process.

A fourth experiment, the Gas Chromatograph Mass Spectrometry Experiment, produced the most convincing evidence that the soils at the Viking landing sites contained no microorganisms. This instrument found no organic molecules within the soil down to a limit of a few parts per million. Even the organic molecules that would be expected in the soils from the accumulation of meteorites like Murchison were absent. Subsequent studies indicated that high chemical reactivity of the soils as well as intense ultraviolet radiation striking the surface would rapidly destroy most organic molecules. Thus, if there is life on Mars, the two Viking spacecraft, which were able only to sample the near-surface soils, were probably looking in the wrong places.

Although instruments on both Viking Landers found no evidence of biological activity in their soil samples, the two Viking orbiters obtained high-resolution photographs of Mars's surface, producing results that excited exobiologists. Several regions on Mars revealed features similar to extensive water flow channels on Earth, leading many geologists to conclude that water had flowed freely on the surface of Mars at some earlier period in its history. Because of the assumed importance of liquid water in the development of life, some exobiologists suggested that life might have developed on Mars in that earlier era and that life might now exist in subsurface layers protected from ultraviolet radiation. Or perhaps such life had gone extinct, leaving only fossil evidence behind.

In 1996 scientists from NASA's Johnson Space Center reported that a meteorite called ALH 84001, one ejected from the surface of Mars and deposited in the Antarctic about thirteen thousand yedrs ago, contained microscopic features that might indicate ancient Martian biological activity. This resulted in renewed interest in the search for life on Mars. These suspected fossils resembled wormlike creatures but their size was extraordinarily small. Many scientists pointed out that similar nanometer sized structures could be produced geochemically and had nothing to do with life. This dispute has not yet been resolved.

After the 1997 Mars Pathfinder exploration of the Red Planet returned amazing images of rocks and terrain, NASA planned a series of robotic spacecraft to continue the exploration of Mars. Two of those spacecraft, the Mars Exploration Rovers named Spirit and Opportunity, launched in June and July 2003, respectively. They successfully landed on Mars in early 2004 and spent at least the next four years moving about their landing sites searching for evidence of water. Later



Public interest in SETI increased dramatically when the movie *Contact* (1997), based on a book by the late Carl Sagan, was released

spacecraft were intended to be even more ambitious, leading to the ultimate desire of exobiologists and planetary scientists alike: a sample return mission from Mars sometime in the second decade of the twenty-first century.

The same techniques used to search for current or fossil life on Mars can be applied to other planets or satellites that are identified as suitable candidates for the development of life. The Galileo spacecraft, placed in orbit around Jupiter in late 1995, obtained close-up photographs of Jupiter's four largest satellites. One of these, Europa, emerged as another potential site for the development of life. One of Galileo's orbits around Jupiter took it within 363 miles of Europa's surface, allowing its cameras to photograph objects as small as 75 feet across.

These images showed evidence of ice flows that had broken from a solid sheet and been displaced, suggesting that they had floated or slipped across a liquid ocean or on a layer of slush below. Calculations indicated that Jupiter's extreme gravitational pull could introduce tidal distortions that produce sufficient heat

to allow liquid water to exist beneath Europa's icy surface. Other photographs showed dark deposits, possibly carbon-rich material contributed by meteorites.

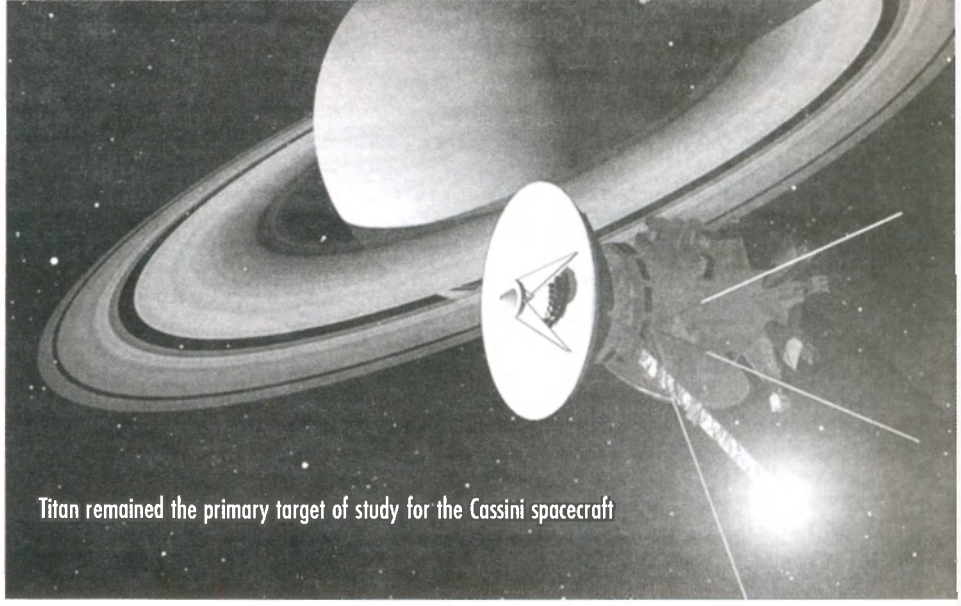
Titan, the largest satellite of Saturn, has a methane-rich atmosphere believed to be similar in composition to that of the early Earth. High-energy electrons and protons, trapped in the magnetic field of Saturn, continually bombard the upper region of Titan's atmosphere. This bombardment is believed to produce complex organic molecules that rain down onto Titan's surface. Titan is too cold to have liquid water.

Titan remained the primary target of study for the Cassini spacecraft, which was launched in October 1997 and arrived in the Saturn system in early July 2004. Cassini dropped its Huygens probe, loaded with instruments to measure the types and abundances of the organic molecules, into Titan's atmosphere. The Huygens probe showed its surface might be covered with lakes of methane or ethane, which some scientists now speculate might be sufficient to allow primitive life to develop. Also, Titan's crust appears to move significantly as if floating on a subsurface ocean, adding another intriguing aspect to the possibility of organic chemistry and/or primitive life on Titan.

Even Enceladus displays unexpected geyser activity at its south polar regions. This suggested the possibility of liquid water underneath the surface and therefore the potential for primitive life. Neptune's Triton also exhibits cryovolcanism at an even lower temperature. More research is needed to determine the nature of this mechanism, and that investigation would likely have to await a Neptune orbiter.

Exobiologists were excited to see the possible existence of the three conditions believed necessary for the development of life: carbon-rich material, water, and energy from the Jovian tides. Several follow-on missions have been suggested. A spacecraft placed into orbit around Europa could use radar to see through several miles of ice, detecting any water below and providing a clear test of the ocean model.

More ambitious proposals include a spacecraft that would fling a 9-kilogram projectile into the surface of Europa, catch some of the debris lofted by the collision, and return it to terrestrial laboratories for examination. Another proposal would see a submersible vehicle melt its way through Europa's icy crust to reach a potential subsurface layer of liquid water and image the local environment directly.



Titan remained the primary target of study for the Cassini spacecraft

The possibility that life might have developed elsewhere in the solar system has been the subject of speculation for hundreds of years. In 1820, Carl Gauss, a German mathematician, suggested cutting geometrical patterns into the Siberian forest large enough to be seen by an observer using a telescope from the Moon or Mars. The idea was to motivate any inhabitants of the Moon or Mars to engineer similar geometrical patterns, initiating crude communication with the Earth.

Other suggestions for communication with intelligent life included setting huge fires in the Sahara desert and constructing large mirrors to reflect sunlight back into space. These early ideas of how to communicate with intelligent life elsewhere in the solar system did not focus on particular sites where the conditions were expected to be appropriate for the development of life.

Although its origins go back as far as 1929, radio astronomy only gained respect within the astronomical community in the early 1950s in the aftermath of World War II, when radio equipment necessary to "listen" to the heavens became available as war surplus. Radio astronomers soon discovered that the natural universe was far from radio quiet. Some scientists, beginning with astronomer Frank Drake, wondered about and then tested the idea that intelligences beyond Earth might be transmitting recognizable radio signals. In due time a coordinated Search for Extraterrestrial Intelligence (SETI) program was developed. No verifiable signals of intelligence have yet been received from deep space, however.

Only in the second half of the twentieth century did biologists begin to develop an understanding of how life originated on Earth. This knowledge provided clues as to the conditions needed for similar forms of life to develop elsewhere in the solar system. The study of terrestrial life indicates that it originated as simple, single-celled microorganisms and that these simple microorganisms might develop quickly and easily on other planets and/or their satellites as well. Thus, the focus of solar system exobiology shifted from the search for intelligent life, which has not been seen on any planet other than Earth, to the search for simple microorganisms.

However, SETI continued, although for a time Congress removed any support for the project, through NASA's federal allocations. In time commercial funds supplemented federal funding for SETI projects. For a time in the period following release of the popular movie *Contact* (1997), based on a book by the late Carl Sagan, public interest in SETI increased dramatically.

The dawn of the space age inaugurated an era when spacecraft could be used to search for environments favourable to the development of life, perform experiments designed to detect living organisms on the surface of other planets and/or their satellites, and ultimately return samples to Earth so that scientists could examine them for evidence of biological activity or fossil evidence of past life.

Mr N. Ramdas Iyer is Curator, National Science Centre, Pragati Maidan, Near Gate No. 1, Bhairon Road, New Delhi-110001

"MINING IS NECESSARY FOR DEVELOPMENT, PEOPLE OWNING SUCH MINING-RICH LANDS SHOULD BE RELOCATED."

WHOSE DEVELOPMENT ARE WE TALKING ABOUT?

Mining is important for development—but whose development? Do the people who are relocated develop? No. Does the environment develop? No. Both are ruined. The only development comes in urban areas located hundreds of miles away; and in the bank accounts of corporate tycoons.

History has shown, and we are still seeing, that the people who are in the immediate vicinity of mining activities have never developed due to those, and neither have the mining rich states of India.

Another point to be noted is that who are the ones eligible to be relocated. Why only the tribals in the hills? One of India's largest oilfields is directly under the city of Ahmedabad, would we even consider relocating the entire city of Ahmedabad? No, never. People give up their farmlands for liquid cash or employment in the mine, but after a few years, the mine is exhausted and the land does not remain fit for cultivation either. What do these people do then? Do we expect the State or the Corporate to take care of these people? Remember, a nation is developed only if it can provide a decent lifestyle to it's citizens, not if it can build malls, flyovers and airport terminals in swanky cities while a majority of it's population have to breathe fly-ash.

Siddhant Sadangi
Govt. Junior College, Bhawanipatna, Odisha, *maverick.becks@gmail.com*

DEPRIVED OF MEANING

Mining is, no doubt, the harbinger for development of a country and its resources, but it also opens up several environmental threats. Mines cause large-scale soil, air and water pollution, such as diffusion of noxious particulate matters, creation of eyesores, declination of wildlife and plant species, siltation of streambeds, accumulation of polluting hazardous materials like Acid Mine Drainage (AMD), asbestos, pyrite (iron sulfide) and several radioactive substances that adversely affect human health as well as environment. Therefore, at present, it is absurd to talk about development through mining because the technology available during this period is not always able to prevent or control environmental damage.

Shayan Ghani
Class-XI, Oriental College, Patna.
shayanghani@yahoo.com

NATIONAL INTEREST IS PARAMOUNT

For all round development of the country it is necessary that its natural resources are optimally utilized. Some Indian states though lagging behind in several ways have been blessed by nature. They are rich in mineral deposits, but the irony is that the local inhabitants are generally unaware of it. They invariably eke out a living using outdated agricultural techniques. It would be in the interest of all that they are shifted to another place where they can earn their livelihood. Of course, they should be adequately compensated. The government should address issues related to families impacted by mining operations, and ensure an holistic reform in the mining sector with special reference to transparency, equity, elimination of discretion and effective redressal of the problems of the displaced persons.

Shashi, Indore

HUMAN CAPITAL MOST IMPORTANT

Our country has a vast reserve of different types of mineral and natural resources. Mineral resources are found at different levels under the earth and it requires excavation of earth layers, which in turn leads to deforestation, decaying of the earth's layer and also displacement of human beings from their natural habitation. Sometimes mining is necessary and has to involve removing people from those areas. Government promises to give them jobs but does not fulfill the promises. This leads to economic imbalance that creates different types of problems. This should not be happen because human capital is the most important capital of the country for its development.

Aditya Varun, Bokaro Steel City

RELOCATION SHOULD BE DONE

No doubt, mining is necessary for development, not for development, actually for sustainable development. Mining plays an important role in developing the economy of a country, or a state. Take an example of "Jharkhand", which has developed its economy on the basis of mining. Due to mining only Jharkhand, Chattisgarh and many other states are developing at a very fast rate.

But there is a dark side to mining too. People owning such mining-rich lands are left alone. They are not given proper price for their land, nor shelter. This is very bad. Government uses their land for development, but does not give them their share. This should not happen. People should be relocated and given proper shelter.

Prafullit Saxena
Delhi University

AMEND LAND ACQUISITION ACT

Despite the fact that mining is necessary for the development of our nation, the difficulties that come in the process of Land Acquisition in India are immense, given the

population density and the type of land use in the country. India has only 2.2% of the world's landmass that caters to almost 16% of the global population. People owning the land are not willing to sell it to the government or any private buyers as is evident from the fact that the fundamental issue in a number of top stories in the past few years has been the Process of Land Acquisition, be it Narmada Bachao Andolan or the recent Nandigram issue. With a number of State Governments demarcating lands as Special Economic Zones the problem just is going to get worse.

The Law of Land Acquisition as it exists today in various forms in different states in India has undergone an evolution in the last decade. Originally the wishes of owners of property were totally irrelevant, but today, the law tries to provide various provisions for objections and alternative remedies in case of inadequacy of compensation. Compulsory acquisition of property involves expropriation of private rights in the property, it is a restraint on the right of private owners to be able to dispose off property according to their wish. The Law of Land Acquisition is intended to legalise the taking up, for public purposes, or for a company, of land which is private property of individuals the owners and occupiers, and pay equitable compensation calculated at market value of land acquired, plus an additional sum on account of compulsory character of acquisition.

Article 31(2) categorically states that a land can be acquired by the state only for Public Purpose, in which the general interest of the community, as opposed to a particular interest of the individual, is generally and vitally concerned. But notions of the scope of the general interest of community change over time. Prime Minister Dr. Manmohan Singh's recent assurance that the Land Acquisition Act of 1894 would be amended is welcome though delayed. There are many compelling reasons why this inept and outdated Act should be changed and the farmers' protest over disruptive acquisition in Uttar Pradesh is only one of them. The 1894 Act, last amended in 1984, has not helped balance the land needs of rapid economic growth and the grievances of those who are divested of the land.

The definition of public purpose that justifies acquisition is ambiguous; the compensation offered is unjustifiably low; and the provisions lack clarity, often requiring courts to intervene. The PM has promised a new, humane displacement policy. This implies, rightly, that the old policy was inhumane. In the holy name of socialism, the government acquired land for any purpose it pleased, public or private, and decided what compensation to give. The abolition of the fundamental Right to Property in 1976 meant that compensation depended on the whim of politicians, not 'farmer' rights. Give villagers an incentive to participate profitably in industrialization, and they will grasp it with both hands. Empower them, and entire villages will offer themselves for sale.

Dr. S. K. Aggarwal
Dean-Academic Affairs
Amritsar College of Engineering and Technology

RELOCATE AND REIMBURSE

There is no doubt behind that India is rich in land resources. In order to develop our country mining is necessary. But mining does not mean disturbing the life of people owning such mining rich lands. So first of all people should be relocated or provided with proper shelter and lands at other places. Only than development of our country is possible.

Nutan Sharma, Samastipur

SUSTAINED MINING

In this technologically advanced age, mining is essential for development. The overall increment in the graph of development of a country depends on the resources it has. India is rich in mines. The Government has to relocate the mine-rich land owning people. But it should be done in a sustained manner. It should not be misused, over-mining will affect land resources. It can increase pollution also.

Shubham Kumar Singh
Patna, Bihar
shubhamkumar50@yahoo.com

RELOCATION NECESSARY

Economy of a country or a state depends mainly on its natural resources. Most of the natural resources are found under ground and land from where such resources are obtained or unearthed is called mining land. For mining such land the government has to take control of the land and so such people have to be relocated.

Ashutosh Shukla
Shree Jain Vidyalaya
ashutosh125india@gmail.com

MINING ESSENTIAL FOR DEVELOPMENT

India is the second largest country as far as its population is concerned and the population is growing day-by-day. When population grows, use of minerals increases. Our country has to import a large amount of minerals to make up for the demand. The cost of many minerals is increasing, due to which we have spend a lot of money. If we have sufficient minerals mines, we do not have to depend on other countries. So the people in rich mineral areas should relocated and provided some economic help.

Roshan Kumar
Class-9th, Saharsa (Bihar)
amitraj492@gmail.com

Now write in your thoughts on this topic:

"Science has perverted the fundamental basis of human relations. With the advent of inventions such as the Internet, television and computer games, we are now communing with a lifeless collection of microchips, not each other."

Be short, crisp and logical. Send in your photo, if you like.

Spectrum

A New Natural Resource?

PARESH R. VAIDYA

If spectrum availability becomes the crunch, ethical issues positing luxury against necessity will obviously arise. They will need to be debated, answered and a stand taken.

THE word 'natural resource' brings to our mind environmental elements like water, land, minerals and petroleum products. One may stretch it to clean air. But no one so far even thought that an intangible and abstract entity called *spectrum* could be a natural resource. And that too with an adjective 'scarce', like any other resource.

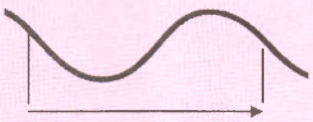
Since the last four or five years a realization has come about the spectrum being scarce and insufficient for our ever expanding needs and hence precious. How else do you explain the windfall income of ₹ 67000 crore accruing from the 'sale' of a small portion of the spectrum; the government itself did not expect more than half that amount! It should look indeed curious that the entity is not perishable, nor consumable and yet it becomes *scarce*.

What is Spectrum?

Spectrum is a distribution of frequencies in a wave or a ray. The most popular example of a spectrum is the rainbow. The visible light from the sunrays is comprised of seven colours from violet to red in the famous sequence VIBGYOR. The same spectrum can be seen if the light is passed through a prism. Every colour in the sequence has its own wavelength increasing from violet to red. Our eyes have the capability to distinguish different wavelengths like 0.00042 mm (for violet) and 0.00066 mm (of red), and hence we recognize all colours differently.

A Wave and Its Frequency

A wave is an oscillation, the kind you see when you drop a stone in a quiet water of a pond. Though it looks progressing outwards, actually the water surface goes up and down at a given location. This motion can be seen as given in the figure here. One wavelength is the distance between two crests or valleys. The number of such oscillations occurring in one second at a given point is called the frequency of the wave. Its unit is Hertz (Hz).



One wavelength

1000 Hz equals 1 kHz
1000 kHz equals 1MHz
1000 MHz equals 1 GHz

The distance traveled in one second i.e. velocity of the wave is equal to the product: Wave length x Frequency.

Velocity for radio waves is 3 lakh kilometers in a second. Using this one can find wavelength for each frequency shown in Fig 1. For waves beyond ultraviolet, it is customary to identify them by energy, which is proportional to the frequency.

Now look at the Fig 1. The visible spectrum here is a tiny part of the larger collection of waves called *Electromagnetic* spectrum (EM Spectrum, for short). Members of this spectrum are quite diverse in nature. Gamma rays, X-rays, infrared radiation, ultraviolet and radio waves including microwaves are all electromagnetic waves but have different properties. This comes from their frequencies that increase from the radio waves towards gamma rays as shown. Corresponding wavelengths are also shown in the figure. All these waves are showered on us from the outer space every minute, but humans learnt about that only in the 20th century because the mechanism of our eyes or any other organ in the body is not suitable to sense any of these waves.

Radio Waves

A significant part of the EM Spectrum is occupied by radio waves. They are a versatile tool and can perform very wide nature of duties for man. Different types of radio broadcasts -- medium wave, short wave, FM and satellite radio, radars for traffic control and weather prediction, wireless communication for police and armed forces, conventional television, Cable TV, radio operated toys, robotics, microwave cooking and cordless phones are the traditional applications of these waves.

They are expanding but at a moderate rate. But applications like mobile phones, Global Positioning systems (GPS), satellite TV, bluetooth etc are newer applications and are expanding at a fast pace.

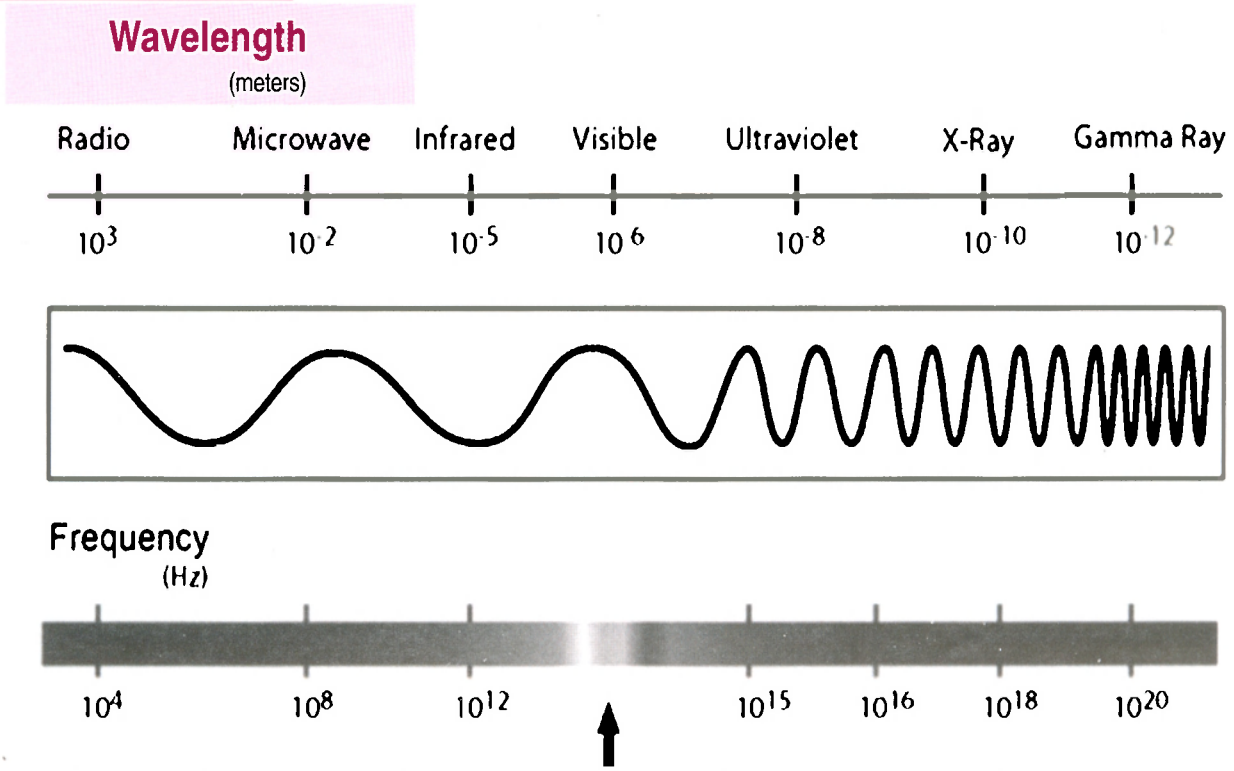


Fig 1. Electromagnetic spectrum. The arrow shows the visible light segment of the spectrum (Picture courtesy www. kollewin.com)

Which frequency is suitable for a particular application, depends upon the nature of application, its sensitivity to directionality, the distance between the instrument and the source etc. These waves have four different categories of penetration. Upto 2 Giga Hertz we have radio waves that can go through building structures/walls and trees. Apart from broadcast radio and television, which are to be used indoors, obvious contenders for a place in this segment are mobile phones.

The second category is semi-penetrating, which can manage some penetration but not through heavy structures or dense objects. They also do not need to have a direct line-of-sight access. Here a narrow band around 2.4 GHz is used for domestic services like cooking, cordless phones, bluetooth etc. DTH TV or police radars meant to detect speedsters can do with higher frequencies that need direct line of sight.

With such a wide nature of demand, frequencies need to be fixed for eoch application and for individual users in order to avoid interference across applications and disputes. Such allocations are done by the International Telecommunication Union (ITU) at the international level and by a Standing Committee in the Department of Telecommunications at the national level for our country. Once such allocation of frequency is done, the particular area of application feels the crunch if demand increases. The world that got increasingly wired during the first half of the last century, took a fancy to getting wireless in the latter half. This put the pressure on radio wave demand.

The first category of penetrating waves was already crowded due to favourable nature of the waves there; these frequencies get more and more 'busy' during wire-less culture. Among them mobile telephony is the fastest growing client. India has 70 crore mobiles ringing today because they do not need arduous cabling any more. That covers 59% of the population!

The landline density has grown only to 3% in these 20 years. This has its own problem. It is like having too many cars on a narrow road; traffic is sure to choke on the upstream side. It results in slow traffic flow and some cars may even stop. Similarly, more telephone traffic on a narrow width of frequency band results in our getting the line engaged or calls drop midway.

The radio frequency spectrum too has this issue though it is not a consumable item. Demand for the bandwidths for various applications is increasing and mobile telephony is the leading consumer.

Shortage of Frequency

Mobile telephony is allotted a nominally wide band of frequencies at two or three spots on the spectrum, viz at 400 MHz, 800 MHz and at 1900 MHz. Some countries have used 2100 MHz zone, which is not a slot of first choice. These bands were adequate, so far as we only wanted to *talk*. But the technology attracts more technology.

After voice, we needed to send written texts (as SMS); later, even more – photographs and songs too! Now this requires higher speed of data transfer, otherwise the song will stutter and pictures will appear in jerks. While 16 kbps (kilo bytes per second) speed is all right for voice content, songs need 128 kbps and data (like picture) may require even 1000kbps i.e. 1 Mbps. If you want to see a picture moving, the demand can be even higher.

Since the last four or five years a realization has come about the spectrum being scarce and insufficient for our ever expanding needs

Faster data transfer needs a wider frequency band, that is, a broader slice on the spectrum line. Although many of the demands may be only for fashion or luxury and not basic need like voice telephone, no government that claims to be progressive can decline the demand for higher frequency bandwidth. The Indian government also did the very thing by *'selling'* the spectrum in 2008 and 2010. (The more appropriate word though is *'allocating'* as we shall see later.)

Unfortunately, this spectrum is not like currency notes that can be printed as done during deficit financing. It is like *'atman'* of *Bhagawad Geeta,* eternal, invisible, non-destroyable (and hence not producible), which was always there and will be there! Thus, however much the government may want to share it with the public, there is a real shortage.

There are two solutions to this scarcity – administrative and technical. As part of the administrative solution the government has requested the defence ministry to vacate some frequencies that were earlier allotted to them. They can move over to other frequencies or change the technology itself – by using fibre optic cable networks. Such cables are delicate to handle in addition to the cost factor.

The technical solution to the shortage is found not by the government but by industry, not in India but abroad. That is, to use the spectrum more efficiently by sending more information using the same width of the frequency band. That is what 3G technology is all about.

2G and 3G

There is no part of the spectrum that can be called 2G or 3G. Thus, strictly speaking, the word '2G Spectrum' is a misnomer. These letters denote the generations of the cell phone technology. Similar usage exists in computer technology where 1G, 2G and 3G indicate progressively advanced generations of technology of the equipment/process.

In the first generation telephony we had analog exchanges. In the 2G or second generation the voice was transmitted in digital form. It is called duplex system because the line on which two persons are talking gets dedicated to that pair of talkers. To use the line more efficiently, more people should be able to use the same line simultaneously. Around the turn of this millennium, 3G technology came that permits this, among other things.

Compared to voice, the data comes in a more interrupted manner. It comes in bursts. There can be gaps between bursts. 3G uses this gap to push data from the other users. For this, the data is broken down into small packets and sent. At the destination these packets from respective users are joined appropriately to make a complete message (which can be a song, a picture or just a voice talk.)

Of course better results require better frequency bandwidth. Against a 2G line needing 30 to 200 kHz, a 3G requires 15 to 20 MHz of bandwidth. But it carries more traffic too. Some of the other issues like incompatibility between various techniques and standards in 2G technology are also addressed in 3G. Paradoxically, some companies are thinking of using spectrum obtained for 3G purposes for 2G applications because of the existing shortage in 2G itself. Some others are waiting for 4G technology to come, which is not far behind.

Sale or Licensing?

The spectrum may be a natural resource, but the waves required for telephony are produced by the respective telephone companies (telcos) and transmitted. They are received by the users' mobile equipments. The governments do not produce the waves required and really do not *own* the spectrum. Hence they do not *sell* it, but only give licence to use it.

This is unlike, for example, the road tax for which it has to prepare roads by spending money. Here the money comes without any investment. As the companies will recover licence fees of ' 67000 crore from the 70 crore mobile users, it works out to be ' 1000 per user. Some 25 years ago also we paid licence fee for playing radio sets, in India. But back then the radio waves (and the programmes) were produced by the All India Radio, a government body, so it could be reconciled. Instead of such decentralized collection from radio owners, money now is collected in single bulk from the telcos. May be this is an efficient mode of earning revenue.

Worldwide there are five methods to allocate licence as described in the Encyclopedia of Electric and Electronic Engineering (Volume 13, page 349).

1. *Over the Counter*. This is same as the 'first come, first served'. This method is fine if supply is more than the demand
2. *Comparative Assessment*. The regulator judges the social responsibility of the bidder and decides.
3. *Lottery*. This is a fair method provided there is no hoarding through proxy bidders.
4. *Tenders*. Good returns expected as rivals do not know bids of each other.
5. *Open tenders*. This method can fetch even better money than tender process. This was used in the latest 3G allotment.

The first ever licensing in our country was in 1996 when the tender method was adopted and fetched amount beyond expectation even in those days.

Sustainability

For all natural resources that are limited in supply, the issue of use within the sustainability boundaries always exists. The radio frequency spectrum too has this issue though it is not a consumable item. Demand for the bandwidths for various applications is increasing and mobile telephony is the leading consumer.

Can its demand be met if we allow ourselves to employ it for non-essential uses like viewing video or television while we are walking? Are such applications more deserving than social applications like telemedicine etc? If spectrum availability becomes the crunch, ethical issues positing luxury against necessity will obviously arise. They will need to be debated, answered and a stand taken.

Dr P.R. Vaidya retired as Scientific Officer (H) and Head, Quality Control Section, QAD, Bhabha Atomic Research Centre (BARC), Mumbai. Address: Flat No 3, Plot 110, Nishant Surabhi, Sector 28, Vashi (New Mumbai)-400703; Tel: 022-27881602; Email: prvaidya@gmail.com

M.S.S. MURTHY

Vainu Bappu

Father of Modern Indian Astronomy

Twinkle, twinkle little star
How I wonder what you are!

MOST children would have wondered at amazement at those little, diamond-like objects shining in the night sky. As they grow up only a few retain that sense of wonder and still fewer probe deeper into the mysteries that abound. This is the story of one such boy – M.K. Vainu Bappu – who went on to be fondly remembered as the "father of modern Indian astronomy".

Manali Kallat Vainu Bappu was born on 10 August 1927 in Hyderabad. His father Manali Kukuzhi Bappu and mother Sunanna both hailed from Kerala.

Vainu Bappu first joined St. Annie's Convent and later the Islamia High School. After high school, he joined the Naizam's College and completed his Bachelor's degree in 1946 and three years later the Master's degree in physics.

From Hyderabad to Harvard

Though Bappu was very good in studies, he had other qualities that made him an all-rounder. He was a gifted speaker, interested in sports, particularly cricket, and literature. But what claimed him as its own was astronomy. As a professional astronomer he used to say, "I learnt astronomy in the lap of my father."

Yes, astronomy was in his blood. His father worked as an astronomer at the Nizamiah Observatory, Hyderabad. Young Bappu used to accompany his father to the observatory and quickly learnt the 'ins' and 'outs' of telescopes and other instruments. He published his first paper on astronomy in 1946 in the journal *Current Science*. The topic was variable stars—those fascinating objects in the sky that vary in brightness periodically. Another short paper in the same journal followed in 1948 on the spectrum of night airglow, using a spectrometer he had himself built.

After his MSc degree, he was keen on pursuing higher studies in astronomy. But, at that time there were no institutions in India offering courses in astronomy and he did not have enough resources to go abroad for studies on his own. However, chance played a benevolent hand here. Professor Harlow Shapley, a renowned astronomer from Harvard University, Boston, USA was visiting Hyderabad. Bappu met him and impressed him so much that the professor promised to do his best to get him admission at Harvard.

In early 1949, Bappu enrolled at the Harvard University with a Government of Hyderabad scholarship. "I will never forget in my life that meeting with Harlow Shapley," Bappu used to acknowledge later in life. That meeting not only gave a prolific astronomer to India but also to the world. For, Bappu rose to adorn the highest chair of international astronomy—the President of the International Astronomical Union.

Donhoe Comet Medal

Comets have fascinated humanity since humans first noticed them with bright distinctive tails streaking across the night sky. They are small members of our solar system and have a great deal to tell about their origin. Hence, discovering new comets is an important aspect of astronomical research. Within a short time after arrival at Harvard, Bappu discovered one.

Donhoe Comet Medal of the Astronomical Society of the Pacific

As part of his work, Bappu was routinely taking night sky pictures. According to *Harvard Crimson*, a daily newspaper of the University, on 2 July 1949 Bappu exposed a photographic plate to the early morning sky. After developing the plate, he announced, "Now I am going to look for comets" and indeed he spotted one after careful examination. His Professor Bart Bok and colleague Gordon Newkirk confirmed the discovery. From several such plates that Bappu took on successive nights they calculated the orbit of the comet to be so large that it would reappear only after 60,000 years!

It is customary to name comets after their discoverers. The International Astronomical Union officially designated the comet as *Bappu-Bok-Newkirk comet (C/1949N1)*. As the first member of the team, Vainu Bappu was awarded the Donhoe Comet Medal of the Astronomical Society of the Pacific. He is the only Indian after whom a comet has been named. But, bigger discoveries from him were yet to come.

Vainu Bappu (1927-1982)

M K Vainu Bappu

Today, astronomy in India has grown leaps and bounds—not just in the optical wavelength but also along the entire electromagnetic spectrum, from infrared to gamma ray.

The Vainu Bappu Observatory in Kavalur (below)

Wilson-Bappu Effect

Bappu completed PhD in 1952, just three years after arriving at Harvard. For his thesis, he carried out spectroscopic studies of a class of stars known as the Wolf-Rayet stars. Immediately, he was offered the prestigious Carnegie Fellowship in astronomy for two years, which gave him an opportunity to work at the largest telescope in USA at that time—a 200-inch Hale Telescope at Mount Palomar. Even here, Bappu was the first Indian to have received this Fellowship. Working with Olin Chaddock Wilson, Bappu came out with an important discovery that etched his name permanently in the annals of astronomy.

While conducting spectroscopic analyses of a class of stars known as late-type stars, they discovered that the width of emission lines of ionized calcium (Ca II K line) in the chromosphere of these stars was proportional to the absolute luminosity of those stars. They studied as many as 185 stars whose luminosities were known and established a calibration curve to demonstrate the relationship. This discovery had a great impact on two areas of research in astronomy; one, it became a convenient tool to determine the distance of those stars; two, it gave an impetus to the study of chromosphere of those stars. Their paper was published in the *Astrophysical Journal* of the American Astronomical Society in 1957 and came to be popularly known as the Wilson-Bappu Effect.

In 1999, the Journal was celebrating the one-hundredth year of its publication. To mark that occasion, it brought out a Centennial Issue that featured 53 articles selected from those published over the past one hundred years with the greatest impact on the development of astrophysics and astronomy. The paper by Wilson and Bappu was one of them.

Home Again

After completion of the Fellowship, Bappu had several job offers from Europe and USA, including one from Harvard itself, but he had determined to return to India. He was aware that from Aryabhata in the 5th century to Sawai Jai Singh in the early 18th century India had a glorious past in astronomy. Nevertheless, when he wanted to pursue astronomy, there were no institutions in the country to teach the subject. While the West was making giant strides in astronomical research by using bigger and bigger telescopes, there were hardly any modern observational facilities in India. Bappu wanted to change all that for posterity. He denied himself all the personal benefits from a job in the West and decided to return home without even the promise a job for his dream of putting India back on the astronomical map of the world.

In the interim period, Prof. K.S.Krishnan, the well-known physicist, arranged for Bappu a fellowship from the National Science Academy, which helped him to carry out some of the work he had brought from Harvard.

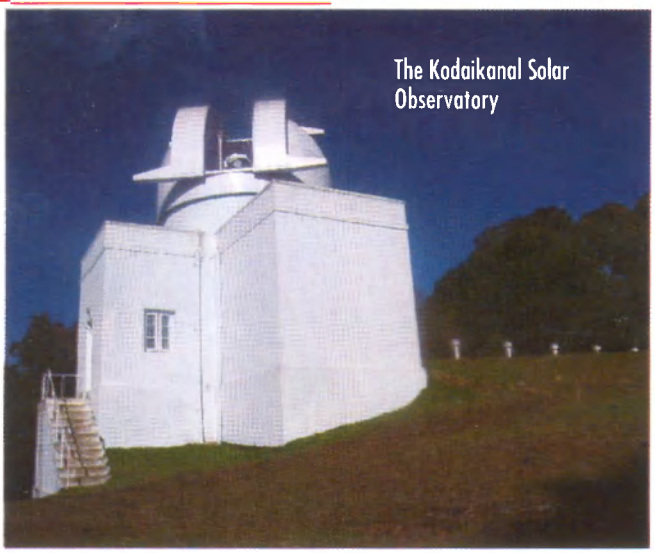
A break came when he was offered the post of Chief Astronomer at the Uttar Pradesh State Observatory, Varanasi. Varanasi was not the best place for an optical observatory, because of the city lights polluting the sky. Bappu shifted the observatory to a more suitable location on Manora Peak, a hilly location near Nainital at the foothills of the Himalayas. In the next few years, he not only equipped the observatory with better instruments but also gathered and trained a group of young astronomers.

As early as in 1945, the Government of India as part of its policy to encourage science and technology constituted a committee under the leadership of the famous astrophysicist Prof. Meghnad Saha to revive astronomical research in the country. The committee recommended steps to improve the existing facilities and to establish a large observatory so that scientists in India could do front-line research in astronomy.

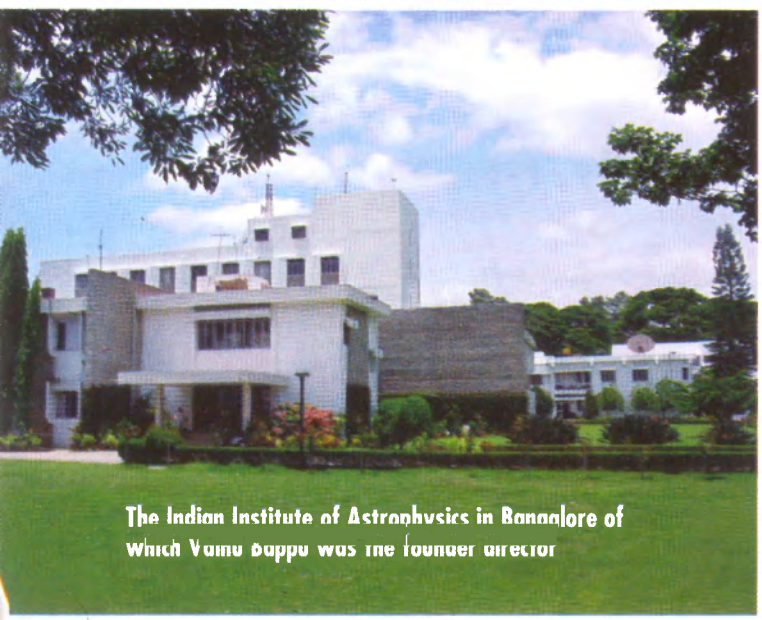
The biggest solar observatory was situated at Kodaikanal. The British originally founded it in 1899. The eminent astronomer Prof. A.K. Das was its Director. The responsibility of carrying out the committee's recommendations fell on Prof. Das. He decided to give priority to those recommendations that could be implemented immediately. He established small observatories at the Universities of Delhi, Agra and Benares to be used for teaching and training graduate students. Then he carried out modernization and expansion of Kodaikanal Observatory and installed a new solar telescope. This enabled Kodaikanal to participate in the International Geophysical Year 1957-58. Prof. Das retired in 1660. Bappu filled his place. He handed over the responsibility of the Nainital Observatory to the batch of young astronomers he had trained and took over the directorship of Kodaikanal. He was just 32 years old.

Kodaikanal was doing excellent work on solar observations. Bappu wanted to extend the activities to stellar observations. But, Kodaikanal was not the best location for a stellar observatory because it is in the path of two monsoons. So he wanted to look for another location where the sky could be clear for a better part of the year. He also wanted the site to be close to the equator in the southern part so that the telescope will have access to almost the entire sky. He combed the entire southern India and finally selected a site amidst the dense sandalwood forest near a village called Kavalur in Tamil Nadu. It was surrounded by hills creating a natural trap for still air. The dense forest-cover reduced ground heating minimizing perturbations to the incoming stellar light.

Bappu immediately started setting up the observatory on a 40-acre forestland near Kavalur. By 1967, a 38-cm telescope, though small from modern standards, was installed and stellar observations started earnestly. Then he persuaded the authorities to purchase a 102-cm telescope from Carl Zesis, Germany. He had planned everything so thoroughly that accessories like the spectrograph and other instruments were ready by the time the



The Kodaikanal Solar Observatory



The Indian Institute of Astrophysics in Bangalore of which Vainu Bappu was the founder director

German engineers installed the telescope in 1972. In fact, he and his associate A.P. Jayarajan, who was a specialist in optical instrumentation, learnt German language much before the German engineers arrived so that they could know from them all the finer aspects of the telescope for independently carrying out the repair and maintenance in future.

Within months after installation, using the 102 cm telescope astronomers at Kavalur discovered the existence of an atmosphere in the Jovian satellite Ganymede. A few years later, they discovered rings around the planet Uranus.

Bappu was not to rest on laurels. He had bigger dreams. At Palomar, he had worked with a 200-inch telescope for stellar observations. His dream was to set up a large stellar observatory in India, comparable to the best anywhere in the world. The Saha Committee's recommendations for setting up a large observatory provided a good platform for him to launch his dream project. He prepared a project report for a 93-inch (234 cm) reflector telescope for Kavalur. It was expensive and finance was hard to come. And there were other administrative problems to overcome.

Indian Institute of Astrophysics

At that time, Kodaikanal and the Kavalur observatories were under the Department of Meteorology of the Government of India. He had to wait for every financial sanction to come from Delhi. He felt that for healthy growth of astronomy in India, it was necessary to have an autonomous organization with its Director having adequate financial powers. With the support of leading scientists of that time, Bappu was able to convince the government and on 1 April 1971 the Indian Institute of Astrophysics was born with the Kodaikanal and Kavalur observatories as its constituents. Bappu was appointed as the founder Director.

In 1975, the Institute established its headquarters in Bangalore opening up various areas of research in astronomy, astrophysics and related topics. He introduced in-house computer facilities to boost research, encouraged seminars and colloquia for free flow of ideas, and training programs for new recruits. Today, the Indian Institute of Astrophysics (IIA) stands as a testimony to Bappu's vision and liberal thinking and has become the cradle of optical astronomy in the country.

Bappu put up a proposal for a 234-cm telescope to the Governing Council of the Institute. To cut costs he offered to indigenize the project as much as possible. Only the mirror blank would be imported. The rest of the jobs like grinding the block to the shape of a parabolic concave mirror, design and construction of the telescope mount, movement and control all would be carried out locally. The Committee approved the proposal and decided that it would be a national facility available for all astronomers in India.

The mirror blank arrived from Germany in May 1974. It was 2.5 meter in diameter, 50 cm thick and weighed four tonnes! By far, the most demanding task in building such a huge telescope was the fabrication of the mirror. The optical experts at the IIA had experience of grinding only small mirrors. Compared with that, this was a gigantic task. However, after a short training abroad they were able to build a special machine that could handle such a huge blank and started the grinding work towards the end of 1979. Because of the high precision required it was an agonizingly slow task

Meanwhile, civil construction of the telescope building at Kavalur also began. Fabrication of the telescope mount, the circular track for rotating the telescope to follow the stars, the telescope dome, etc were entrusted to specialist workshops in different parts of the country. When everything was going smooth, tragedy struck. Suddenly, Bappu was no more.

A One Way Journey

During all these institution-building activities, Bappu did not ignore his research interest in astronomy. He continued the study of Wolf-Rayet stars and calcium emission lines in stellar chromosphere and finally became an authority on those subjects. He had more than 90 scientific publications. And he loved chasing solar eclipses wherever they occurred to study solar corona. For his outstanding contribution to astronomy he received many awards, both Indian and foreign. The President of India decorated him with Padma Bhushan in 1981. His highest recognition came when he was elected President of the International Astronomical Union for the years 1979-1982, an honour that made the entire astronomical community in India proud.

(Continued on page 43)

Herbal Manicure & Pedicure, Anyone?

SHAZIA AND M.B. SIDDIQUI

A well-turned out appearance imbues you with a sense of confidence. One aspect that makes for an appealing personality is a manicured hand. A manicure involves trimming the nails, shaping the nails, pushing back the cuticle, or removing any type of hang nail you might have. This also helps your nails grow by pushing the skin that comes off the nail plate. Beautiful nails impart your hand with a character and, obviously, are good at look at.

A manicure treatment, of course, goes beyond the treatment of nails. It could involve a massage of the hands too with a softening substance. This procedure can also be applied to the toenails and feet and is referred to as a pedicure.

A pedicure involves shaping and cutting the toenails, pushing back the cuticles, and taking off unwanted calluses on the feet. A pedicure, thus, improves the appearance of the feet and the nails. Additionally, leg care below the knee is also commonly included in pedicures. Leg care includes depilation through shaving or waxing followed by granular exfoliation, application of moisturizing creams and a brief leg massage.

But why always rely on synthetic creams when you could use plant oils and chemicals derived from several plants to accomplish your manicure and pedicure? There are several plants extracts from which could help take good care of your hands and feet. Take a look at some of them.

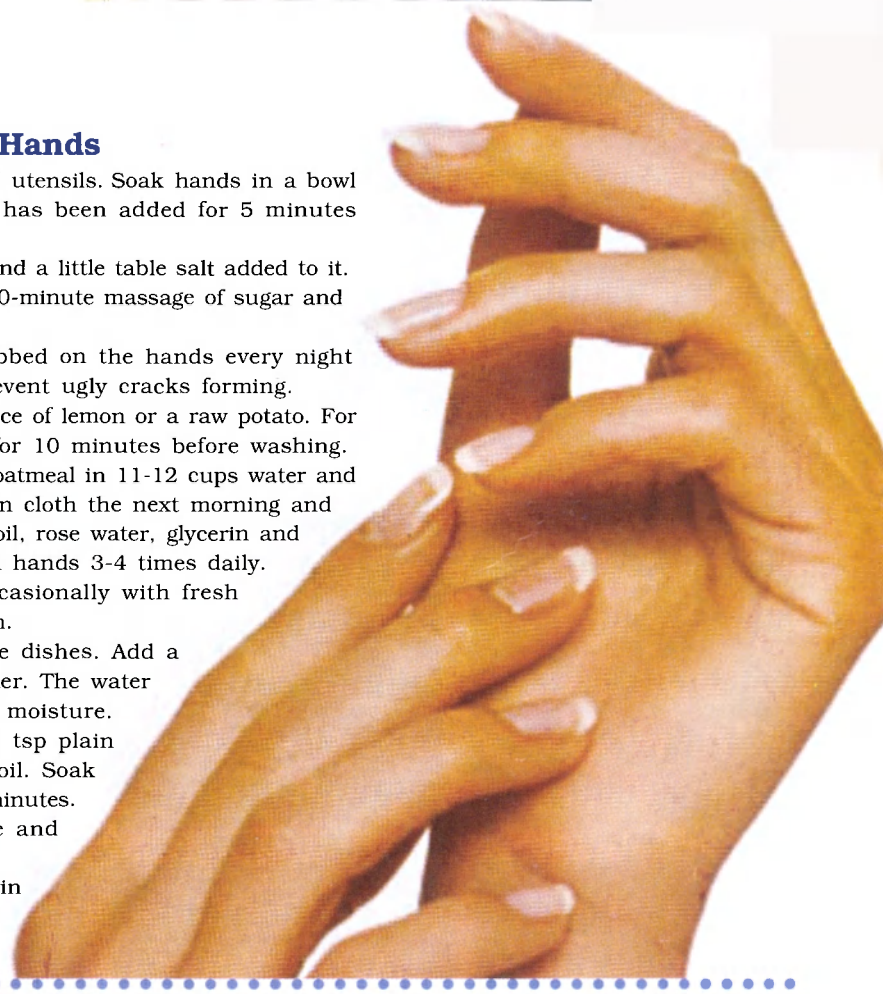
ONION (*Allium cepa*): Roast an onion, make a paste and use it on the cracks on your feet. The cracks will disappear within a month's time. In many parts of the world, onions are used to heal blisters and boils. A traditional Maltese remedy for sea urchin wounds is to tie half a baked onion to the afflicted area overnight. In the United States, products that contain onion extract are used in the treatment of topical scars and may also act as a skin anti-inflammatory.

ALOE (*Aloe vera*): *Aloe vera* is a medicinal plant that has been used for curing many skin diseases for centuries. Aloe is used for heoling cuts and bruises. The most common form of Aloe is topical ointment as aloe jelly. These are natural extracts of leaves of *Aloe vera* plants. The vitamins and soothing coolness of the aloe gel relieve swelling of the skin. The gel is also known to soften the skin as well as repair the cells, so the skin heals faster. This gel can be obtained by cutting the leaves in half along their length and then rubbing the inner pulp over the skin of hands and toe for smoothness and softness.

PEPPERMINT (*Mentha piperita*): Peppermint relaxes the muscles and is also used to relieve itching, inflammations, and a variety of respiratory conditions. Peppermint, when applied topically, has a soothing and cooling effect on skin irritations. The essential oil can also be diluted with oil and applied to the hand and feet. Peppermint oil contains Menthol, which is good for the skin. It gives a cooling effect. Further it nourishes dull skin and improves oily skin. The peppermint oil is rejuvenating and is used in scented spa

Tips For Lovely Hands

- Always use gloves for washing clothes and utensils. Soak hands in a bowl of warm water to which 1 tsp of cornstarch has been added for 5 minutes daily after finishing the household chores.
- Massage hands once a week with olive oil and a little table salt added to it.
- Remove ingrained dirt from hands with a 10-minute massage of sugar and butter.
- Glycerin, rose water and lemon juice rubbed on the hands every night during winter months keep them soft and prevent ugly cracks forming.
- To remove stains from hands rub with a slice of lemon or a raw potato. For nicotine stains, apply lemon juice and leave for 10 minutes before washing.
- To keep hands clean and soft, soak 250 g oatmeal in 11-12 cups water and leave overnight. Strain it through a thin muslin cloth the next morning and add 1 tsp lemon juice and 1 tsp each of olive oil, rose water, glycerin and diluted ammonia. Store in bottle and apply on hands 3-4 times daily.
- Keep knees smooth by rubbing them occasionally with fresh limejuice or massage with a nourishing cream.
- Soften your hands even while you do the dishes. Add a little almond oil (about a teaspoon) to dishwater. The water will soften rough skin while the oil seals the moisture.
- Take 1/2-cup warm milk, 2 tsp sugar, 2 tsp plain yogurt and a few drops of lavender essential oil. Soak your hands/fingers in this mixture for about 5 minutes. Then do a scrub, nail/cuticle care, massage and polish.
- For rough palms, use a mixture of glycerin and limejuice in equal proportion.



treatments, lotions, scrubs, and massage blends.

APPLE CIDER (Cider vinegar, ACV, Acetic acid): Apple cider vinegar is a type of vinegar made by the fermentation of apple cider. During this process, sugar in the apple cider is broken down by bacteria and yeast into alcohol and then into vinegar. Apple cider vinegar contains acetic acid (like other types of vinegar) and some lactic, citric and malic acids. Natural Apple Cider Vinegar is a wonderful natural cure for a number of ailments that usually require antibiotics and other medications that have a number of side effects. In particular, hand and feet massage by apple cider vinegar has been known to cure skin conditions, fight allergies, prevent muscle fatigue after exercise and increase stamina.

LEMON (*Citrus limon*): Lemon is a cheap and easily available citrus fruit, known for its medicinal and culinary uses. Lemon is a rich source of vitamin C, riboflavin and vitamin B, minerals such as phosphorus, calcium etc and carbohydrates and proteins. Skin problems can be cured with the help of lemon juice since lemon is a natural antiseptic. Rubbing and scrubbing the hand and feet with lemon can help you get rid it of dead cells. Lemon water can also lighten burn scars and reduce burning sensation of the skin of either hand or toe.

TOOTHACHE PLANT (*Spilanthes acmella*): *Spilanthes* contains an essential oil, spilanthole, which is anti-inflammatory in action. It also contains tannic acid, which has an astringent action. Traditionally it has been used externally to relieve pain and swelling. An Indian tribe used the herb to treat fungal skin conditions, and also formulated the herb into a tincture to be used for external fungal infections such as athlete's foot, ringworm and nail infections.

Nail Fungus (also called *Tinea unguium* or onychomychosis) affects the fingernails and toenails. This disease is commonly misunderstood and left untreated for various reasons. The fungi that cause toenail fungus are related to those that cause ringworm, athlete's foot, and other common fungal infections. Toenail fungus, in particular, is notoriously difficult to treat. Leaves of the toothache plant can be applied to the affected parts to get rid of these problems.

OLIVE OIL (*Olea europaea*): In addition to the internal health benefits of olive oil, topical application is quite popular with fans of natural health remedies. Extra virgin olive oil is the preferred grade for moisturizing the skin, especially when used in the oil cleansing method (OCM). OCM is a method of cleansing and moisturizing the face with a mixture of extra virgin olive oil. In many countries, women regularly use the oil of olive to take care of their hands and legs.

LAVENDER OIL (*Lavandula officinalis*): Lavender flowers have long been known for their healing properties. When infused in oil, lavender soothes sore, aching muscles and creates a mentally soothing environment that relaxes both the mind and the body. Lavender oil can be added to bath water, homemade soaps and used in facial products. Commercially, lavender massage oil is available, which is specially formulated for using in massage and aromatherapy. Lavender essential oil is excellent for the skin. Adding its extract to soaps and


Allium cepa


Aloe vera


Mentha piperita


Cider vinegar


Citrus limon


Spilanthes acmella


Olea europaea


L. officinalis


Origanum vulgare


Helianthus annuus


Borago officinalis

Honey

A manicure involves trimming the nails, shaping the nails, pushing back the cuticle, or removing any type of hang nail you might have. This also helps your nails grow by pushing the skin that comes off the nail plate.

Beautiful nails impart your hand with a character.

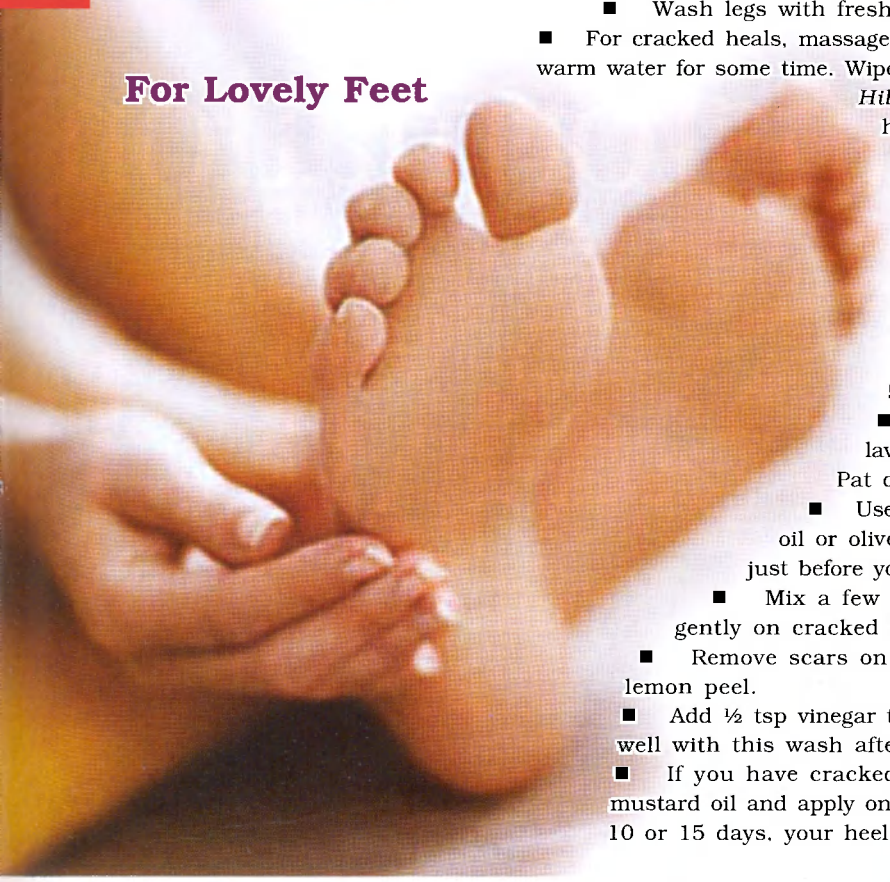
bathwater gives off a fresh fragrance. It also helps repair skin problems while making the skin feel invigorated and fresh as a bumblebee.

OREGANO OIL (*Origanum vulgare*): It is a species of *Origanum* of the mint family and a perennial herb. It is effective in fungal infections of nails and skin. When spread over the affected area, the oil penetrates through the nail to kill the fungus underneath. When rubbed between the toes the oil can relieve athlete's foot problems. Oil of Oregano can be applied directly onto the skin to treat itches, skin infections but only if it has been diluted. Always follow the instructions on your particular bottle before applying topically onto the skin, since highly concentrated oils may first need to be mixed with Olive Oil or Coconut Oil before application (usually one teaspoon of Olive Oil or Coconut Oil per one drop of Oil of Oregano).

SUNFLOWER OIL (*Helianthus annuus*): Sunflower oil is the non-volatile oil expressed from sunflower seeds. It is used as an emollient. Sunflower oil is high in the essential vitamin E and low in saturated fat, which helps to retain moisture in the skin of hands and feet.

PEPPERMINT OIL (*Mentha piperita*): Peppermint oil can be used externally for providing relief from pain. The essential oil

For Lovely Feet



- Wash legs with fresh water and wipe with clean towels.
- For cracked heals, massage the foot with coconut oil and keep the foot in warm water for some time. Wipe the water off the feet and apply a mixture of *Hibiscus* (china-rose) flower (10), Henna (1 handful) and juice of half a lemon. When dry wash it off.
- You can also make a foot pack of oatmeal, powdered almonds, lemon peel, fresh cream and gram flour. Massage this into the feet at night in rotating movement.
- If knees are dark than the rest of the leg, mix lemon juice, curd, and wheat flour and make like paste and apply, and remove after 5 minutes.
- If your feet sweat too much mix 10 drops of lavender water and soak feet in it for 15 minutes. Pat dry and apply boric powder.
- Use 10 drops of sandalwood oil in 100ml coconut oil or olive oil and massage your leg or the entire body just before your bath.
- Mix a few drops of lemon juice in Vaseline and apply gently on cracked heels.
- Remove scars on your hands and feet by rubbing them with lemon peel.
- Add ½ tsp vinegar to ½ a cup of curds. Massage feet and ankles well with this wash after 5 minutes.
- If you have cracked heels, melt paraffin wax; mix it with little mustard oil and apply on the affected area and leave it overnight. After 10 or 15 days, your heels will become smooth.

Bleach could kill just about any type of organism, including living skin. So, it is not a chemical to be treated lightly.

can also be diluted with other oils and applied to the skin. It is believed that the presence of calcium antagonism in peppermint oil aids in removing pain. Peppermint oil contains Menthol, which is good for skin and gives a cooling effect. Further it nourishes dull skin and improves oily skin.

BORAGE OIL (*Borago officinalis*): Borage oil is derived from the seeds of the borage plant. It is a natural oil that not only restores moisture and smoothness to dry and damaged skin, but can also provide relief to people who suffer from chronic skin disorders. For everyday use, borage oil has been shown to be very effective in treating redness, inflammation, and moisture loss associated with dry skin of either hands or feet.

A pedicure involves shaping and cutting the toenails, pushing back the cuticles, and taking off unwanted calluses on the feet.

Nurturing Nails

Here are a few home remedies that will keep your nails in good condition.

VICKS VAPORUB: Best and easiest and safest method of getting rid of nail fungus is Vicks vaporub. It has been suggested that the menthol, camphor, and eucalyptus in Vicks could be what inhibits or kills the fungi. Just rub it on your toenails at night and with a sock to keep your bedding clean. It is totally harmless, although it has its own smell. It may be best suited for the toenails, but may be worth experimenting for fingernail infections too.

VINEGAR: Vinegar is also a common recommendation for treating nail fungus. It is applied to the site of infection two times daily. Apparently this works by making the infected area more acidic. Fungi seem to have trouble living in environments that have an acidic pH balance. Vinegar has a rather strong smell, and it may be noticeable to people around you. This is another reason to go with commercial products, though sometimes they have a distinctive medical smell to them. It is important to regularly apply whatever treatment you are using, as recommended. Skipping treatments can give the infection a chance to rebound.

BLEACH: We certainly can't recommend any of these treatments, especially one as severe as bleach. However, bleach or products that contain it, have produced positive results on nail fungus. It should be noted that bleach could kill just about any type of organism, including living skin. So it is not a chemical to be treated lightly. It can also bleach your clothing, sheets, and even furniture. Given all of these facts, we feel that there are certainly better and more convenient treatment options for fungal nail infections.

Ms Shazia (shazia.amu@gmail.com) and Dr. M.B. Siddiqui (zaman.amu@mail.com) are with the Department of Botany, Aligarh Muslim University, Aligarh-202002.

The Transformation

Samiya Fatima

He still remembered the ill treatment by his childhood friends—one of them was standing right in front of him. Like the saying goes, 'every dog has his days', it was the scientist's day today. The couple was begging for a few bugs but they wouldn't get it so easily at least not from this troubled childhood friend.

IN a desolated, downtrodden, deserted laboratory in a far away land, a scientist with crumply fuzzy hair was jumping with joy. His years of hard-core research had finally paid off. With tears of joy rolling down his wrinkly cheeks, he was envisioning flashbacks down the memory lane when as a child he would dream about this day. The day he was longing for thirty odd years had finally arrived. He wanted to hug them, kiss them, but all he could do was weep in joy.

The memory was fresh in his mind, how he would turn red in anger and embarrassment when all his friends would lock him up in a little cage they had made with their half broken wickets in the backyard of their apartment building. He was treated as an untouchable. They would taunt him because of the head lice he was afflicted with.

One evening when he was teased and locked up in the same creepy little cage, an idea popped up in his tiny mind. His biology teacher had spoken about transgenic organisms the same day. And so the thought struck him. Could he transform the head lice into some sort of Super Bugs!

Since that day his only goal in life had been to realise that dream. He took great interest in genetics and pediculus organisms. And now that he had achieved success in the only goal of his life—turning head lice into super bugs—he could sigh in relief. But his work was not over yet. There was still a big problem to which a solution had to be found. He had his super bugs right in front of him but how was he to prove that to the cruel and stubborn world?

He had to market his super lice. And for that he needed enough proof that his super bugs did indeed work wonders. He had already tested the super bugs in his laboratory. The tests had been immensely successful. Now all he had to do was find out a way to roll out his product in the market. He couldn't help but imagine the scenario after word about the super louse bug had spread far and wide.

He spread the bug in one town first. Then when results came pouring in he had solid proof to show to the rest of the world. Soon things started to fall on track and one thing led to the other smoothly. Finally, his job of marketing the super bug had achieved unprecedented success.

Head lice were now a revolution. Everyone wanted to be infested by it like crazy. It did wonders to the development of mankind too. The old fuzzy haired scientist had not only transformed head lice into super bugs but he had made different kinds of them. There were basically two types of super head lice bugs:

a. *Scalp-smoothers:* Their primary aim was scalp health. Scalp became smooth and very productive, making it perfect for hair growth. The best part was that there would be no signs of dandruff.
b. *Hairexhilarating:* Their target was hair. All aspects of hair, be it length, texture, amount, colour, basically the general health was enhanced in bounds. This was the favourite of girls and hair-obsessed boys.

With the little players in place all the scientist had to do was sit back, relax and watch the game being played. He never expected his project to be such a success. Youngsters carried their super head bugs as a fashion statement. It was like wearing worn and torn out jeans in the days past, looked weird but considered very cool. Every one trying so hard to keep those bugs on them, wearing caps so they don't escape out, eating blood forming stuff just to nourish them, trying to sweeten their blood to attract more bugs and what not. It was crazy!

The head lice were considered the "in" thing. Not having them was considered an awful thing as opposed to the scenario a few years ago when people infested with head lice were ridiculed and considered filthy. Now, people were going all out to have their head infested with head lice.

Considerable care was even given to the head lice's likes and dislikes. Head lice, for a fact, love clean and healthy heads, so everyone made sure their heads were clean and made a point not use stuff like olive oil or mayonnaise that suffocate the crawly creatures. People rarely combed their head worrying they might hurt the crawly bugs. Some time back people would be ashamed if they got nits and would try to hide them by wearing scarfs but now nits were proudly displayed.

Corporates also took advantage of the situation. Innumerable products targeting every little aspect of the lice's life were out in the market. Salons came up with treatments that would make the head an ideal home for the super head lice. Advertisements displaying the products were everywhere,

on TV channels, newspapers, and even Internet. Special slogans were made such as-

If you use this product,
They'll think you're looking for a renter
And make your head a day care centre.
You'll be asked to baby-sit
Their cherished offspring, nymph and nit.
Then having left their mark on you
They'll move to your sister Sue.

They'll come by dozens
And bring all their cousins.

Every hair is a slide
Where they can crawl down and hide.

The scientist looked around and was amazed and immensely happy to see that kids were trading louse just like he would trade Pokemon toys with his friends during his childhood. There were communities and groups on networking sites and even schools for even specific kinds of super lice. Louse was now a sign of high status. He was glad that little girls no longer had to go through the excruciating pain of lice removal; no one had to put harsh chemicals on their head trying to get rid of the crawling creatures.

Of course, head lice had even been found on human mummies, they were also mentioned in the Bible. Long time ago, Aztecs collected their head lice in bags and offered them to their Emperor as a token of respect. Young women in North Siberia threw lice at men as a sign of affection as if to say 'My louse is thy louse'. But with time the outlook had changed and the louse came to be considered extremely unhygienic—the parents' worst nightmare. He remembered the humiliation his mother suffered, the agonising pain he suffered trying to remove the little harmless crawling creatures from his soft head. He also remembered the letters and phone calls his parents would receive from the school asking them to keep the kid off school premises until he was free from lice.

He was amazed how tampering a few letters in the genetic code of the head lice completely changed their fortunes forever—and his too.

He had to market his super lice. And for that he needed enough proof that his super bugs did indeed work wonders.

And then the incident he had been waiting for all these days finally came to pass. Since head lice had become much sought after products, the poor creatures were not able to reproduce in such high numbers. Shops selling them were soon running out of stock. People were running from to shop to shop in search of the super bugs.

One such couple, after knocking at the doors of many shops, finally landed at the fuzzy-haired scientist's home. As he opened the door, the scientist was surprised to find his childhood friend with his wife, both wearing a harried look on their faces. The scientist was barely able to suppress a smirk at their pitiable situation.

He still remembered the ill treatment by his childhood friends—one of them was standing right in front of him. Like the saying goes, 'every dog has his days', it was the scientist's day today. The couple was begging for a few bugs but they wouldn't get it so easily at least not from this troubled childhood friend.

The scientist made his childhood friend remember the days when he along with his other cronies made him suffer such humiliation. He told him how he longed for friends then, how he wished that at least one single soul would sympathise with him, how painful it was for him to shave his head off so many times in an attempt to get rid of lice. The friend listened to him with downcast eyes.

After he had poured out all his pent up anger, he felt a great sense of relief. He now felt pity looking at the poor couple's faces. He went inside and brought a couple of his marvellous creations and handed it over to them. He watched happily as the ecstatic couple made their way back home, itching their super lice infested heads.

Contributed by Ms Samiya Fatima, c/o Badruddin Khan, H.No-16-2-55, Akbar Bagh, Hyderabad- 500036

UNDER REGULATION COULD BENEFIT BIOTECH SECTOR

RAJNEESH K. GAUR

IN recent times, Infotech and Biotech have been the two most popular buzzwords in India. While the Indian Information Technology sector has created thousands of jobs and accounts for 5.9% of the country's GDP, the Biotech sector is still considered relatively young. The difference between the two industries is the public acceptance, jobs available, technical and regulatory issues, duration required to introduce a product into the market and so on.

Is there anything that the biotech sector can learn from the IT sector at the policy level? Indeed, there is definitely an astronomical difference in the regulatory aspects of IT and Biotech related products. IT industries are driven mainly by the market needs and the immediate utility of the product. Therefore, the world over governmental regulation is minimal in the innovation as well as in the commercialization of IT technology and the resulting products. Does that mean the biotech sector has excessive and over-stringent regulations that might not be required and may possibly be hindering the innovation and commercialization of the biotech products?

Biotechnology like IT is growing tremendously and the major beneficiaries of these biotechnology advancements are largely the citizens of wealthy countries—an indication that the world is biotechnologically divided. One of the main reasons for this division is significant difference between regulatory issues among the countries of the world. For example, the world is divided over the issues of genetically modified organisms and crops. Europe has ceased all its research related to GM crops and cultivation is not permitted while India has relaxed regulation on this issue and therefore not only allowed cultivation for research purpose but also approved Bt cotton with rich dividends.

REGULATORY ISSUES OFTEN LEAD TO PUBLIC DISCUSSIONS. FOR EXAMPLE, IN INDIA, BT BRINJAL IS AN OUTCOME OF HIGHLY COMMITTED, SOCIETAL NEED BASED, SCIENTIFIC RESEARCH BUT THE PUBLIC DISCUSSION OF THE SCIENTIFIC AND REGULATORY ISSUES JEOPARDIZES THE FRUITFULNESS OF THE ENTIRE RESEARCH.

The major issue is how one can exploit this difference in regulatory process or find a way to comply with them in a more innovative way. Since European research related to GM crops has come to a halt due to the ban by regulatory authorities, there is a lot of potential and commercializable market product lying in the European laboratories. If the developing nations can seize the initiative and collaborate to develop these products further and allow them to be tested, then they can be benefited via IP sharing and opening their countries market to foreign investment.

Apart from economic development, such an initiative would also result in trained and skilled manpower development. Such an initiative would also provide an opportunity for high developing nations to penetrate the markets of less developed developing nations through technology transfer. For example, recently Philippines announced the approval of Bt Brinjal, prepared as a hybrid in association with Mahyco seed corporation, India. The Philippines government also used the Indian biosafety dossier for its own approval of Bt brinjal.

Secondly, regulatory issues often lead to public discussions. For example, In India, Bt brinjal is an outcome of highly committed, societal need based, scientific research but the public discussion of the scientific and regulatory issues jeopardizes the fruitfulness of the entire research. It has also thwarted the early commercialization of the product and also put a question mark on the agricultural research based on genetic modifications.

Thirdly, strict regulatory issues can also impede the innovative ability of a researcher or an organization. For example, the small pox vaccine innovation was a result of the variolation directly carried out on human beings. The intention is not to plead for testing all biotech products directly on human beings. But in view of the dilemma researchers face in complying with regulations, there is a need to bring in some flexibility in genuine cases.

The best option would be to promote the concept of "animal safari" for scientific purposes. In these safaris, animals required for scientific purpose can be bred, well fed and all the tests can be performed in compliance with regulation without the fear of making the animals endangered. Similarly for testing genetically modified plants, we need to build "plant safaris" so that the innovations getting funded can contribute to the direct growth of the GDP of the country parallel to the IT sector.

Dr. Rajneesh K. Gaur is Scientist 'C', Room No. 814, Department of Biotechnology, Ministry of Science and Technology, Block II, 8th Floor, CGO Complex, Lodhi Road, New Delhi–110003; Email: rajneesh.gaur@nic.in

DILESWAR NAYAK & POONAM WARPA

PESTICIDE QUIZ

1. **Acaricide is used to control**
   a. Mites and ticks b. Rat
   c. Birds d. None of the above
2. **Algaecide is used to control**
   a. Crocodile b. Fungi
   c. Algae d. All of the above
3. **Antifouling agent is a paint additive used to**
   a. Protect against organisms that grow on moist or wet surfaces including those underwater
   b. Protect against organisms that grow on dry surfaces
   c. Protect against organisms that grow on rocky surfaces
   d. All of the above
4. **Attractant is a chemical that**
   a. Attracts insects to a trap or a poison
   b. Attracts birds and animal pests to a trap or a poison
   c. Both a and b
   d. All of the above
5. **Avicide**
   a. Kills or discourages birds b. Attracts birds
   c. Is a Bird feed d. None of the above
6. **Chemosterilant means**
   a. A chemical that will enhance reproduction by a pest
   b. A chemical that will lower or stop reproduction by a pest
   c. Both a and b
   d. All of the above
7. **Defoliant is**
   a. A chemical that induces plants for dwarfed growth
   b. A chemical that induces plants for vigorous growth
   c. A chemical that induces plants to drop their leaves prior to harvest
   d. None of the above
8. **Desiccant means**
   a. A chemical that keeps plants green
   b. Disrupts water balance in arthropods
   c. Both a and b
   d. None of the above
9. **Fumigant is used to**
   a. Kill leaf insects
   b. Kill soil pests and sometimes weeds
   c. Both a and b
   d. None of the above
10. **Fungicide is used against**
    a. Fungi b. Reptiles
    c. Both a and b d. All of the above
11. **Herbicide is a**
    a. Growth promoter b. A weed killer
    c. Both a and b d. None of the above
12. **Insecticide is used against**
    a. Insects b. Human
    c. Both a and b d. None of the above
13. **Molluscide is**
    a. Used to kill or control wild animals
    b. Used to kill or control mollusks and other invertebrates
    c. Both a and b
    d. None of the above
14. **Nematicide is**
    a. Used to kill or control big size insects
    b. Used against nematodes
    c. Both a and b
    d. None of the above
15. **Ovicide is**
    a. A chemical used against the chicks of birds
    b. A chemical used against the eggs of insects, mites and nematodes
    c. Both a and b
    d. All of the above
16. **Piscicide is**
    a. Used to reduce the population of wild animals in the forest
    b. Used to reduce the population of rough fish in a water body
    c. Both a and b
    d. None of the above
17. **Plant regulator is**
    a. A chemical that alters the normal pattern of growth and development of a plant
    b. A chemical that kills the plant
    c. Both a and b
    d. None of the above
18. **Repellent is**
    a. A chemical that repels insects or other animals
    b. A chemical that attract insects and other animals
    c. Both a and b
    d. All of the above
19. **Rodenticide is used against**
    a. Birds
    b. Mice, rats and other rodents
    c. Fish
    d. None of the above

ANSWERS:

1. a	2. c	3. a	4. c	5. a	6. c	7. c	8. b
9. b	10. a	11. b	12. a	13. b	14. b	15. b	16. b
17. a	18. a	19. b					

Contributed by Mr Dileswar Nayak, Assistant Professor (NRM), Department of Natural Resource Management, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Dandi Road, Navsari-396450, Gujarat; Email: nutan.nayak@gmail.com and Ms Poonam Warpa, Post Graduate Scholar, Department of Tree Improvement and Genetic Resources, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan-173230 (H.P.)

JAGDISH VALECHA

GENE THERAPY

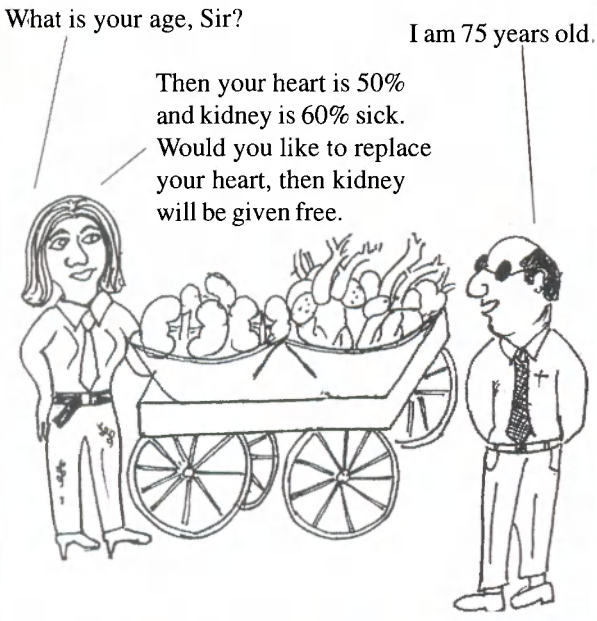
1. **Which process is used to insert normal genes into human cells to correct disorders?**
   a) Gene therapy b) Live vector vaccines
   c) Molecular cloning d) Stem cell therapy
2. **Most current gene therapy trials target...**
   a) SCID deficiency b) Cancer
   c) Cystic fibrosis d) HIV
3. **Gene therapy targeting the germ-line is...**
   a) Heritable b) Not heritable
   c) Sometimes heritable d) Unrelated to heritabilify
4. **Which deficiency of the immune system was the first disorder researchers treated with gene therapy?**
   a) Adenosine deaminase deficiency (ADA)
   b) Ornithine transcarbamylase (OTC)
   c) Duchenne muscular dystrophy (DMD)
   d) Sickle Cell Anemia (SCA)
5. **Which part of the human body bone marrow cells are removed from to perform ex vivo SCID gene therapy?**
   a) Lung b) Skull
   c) Hip bone d) Spinal cord
6. **Which of the following is an example of a condition caused by a mutation in a single gene?**
   a) Colon cancer b) Heart disease
   c) AIDS d) Cystic fibrosis
7. **What is gene therapy?**
   a) Pre-clinical testing for inherited diseases in newborns
   b) Treatment of diseases caused by genetic defect
   c) Genetic engineering using recombinant DNA technology
   d) Cancer treatment using in vitro cultured stem cells
8. **Germline gene therapy could potentially correct a genetic defect in a(n)...**
   a) Affected individual only
   b) Affected individual and his or her offspring only
   c) Affected individual and all of his or her descendants
   d) Parent of an affected child
9. **A mechanism of gene therapy involving the alteration of myoblasts could be used to treat...**
   a) Parkinson disease b) Muscular dystrophy
   c) Prostate cancer d) Tay-Sachs disease
10. **Which of the following is a preferred vector for transferring genes to nerve cells?**
    a) Adeno-dssociated viral vector
    b) Herpes Simplex viral vector
    c) Retroviral vector
    d) Vaccinia vector
11. **Which of the following genetic therapies has been used to treat familial hypercholesterolemia?**
    a) Suicide gene therapy
    b) Insertion of LDL receptor cells
    c) Immunomodulatory gene therapy
    d) Suppression of oncogenes
12. **Which gene transfer technique involves the use of a fatty bubble to carry a gene into a somatic cell?**
    a) Electroporation b) Liposome transfer
    c) Microinjection d) Particle bombardment
13. **Market registration of a gene therapy product in Europe requires approval by which of the following organizations?**
    a) EMA b) FDA
    c) NIH d) WHO
14. **What is the main objective of a phase I clinical gene therapy trial?**
    a) Assessment of the safety of the gene therapy product
    b) Evaluate the optimal doses of the gene therapy product
    c) Provide scientific proof of successful treatment
    d) Provide pre-clinical safety data for clinical studies
15. **Which cell type would not be a direct target for gene therapy?**
    a) Red Blood b) Muscle
    c) Liver d) Endothelium
16. **Haematopoietic stem cells used in gene therapy can be obtained from...**
    a) The embryo b) The fetus
    c) The placenta d) The cord blood
17. **Which gene is often removed to create replication-deficient adenoviruses?**
    a) E I b) L I
    c) E3 d) L5
18. **Which of the following viral vectors are most often used in clinical gene therapy trials?**
    a) Lentiviral vectors
    b) Vaccinia vectors
    c) Adeno-associated viral vectors
    d) Adenoviral vectors
19. **What is in general not a risk factor in gene therapy using adenoviruses?**
    a) Insertional mutdgenesis
    b) Overexpression leading to an immune reaction
    c) Generation of replication competent adenoviruses
    d) Toxicity due to the administered viral dose
20. **What is not a product name for a replication deficient adenoviral vector containing the p53 gene?**
    a) Gendicine b) Advexin
    c) SCH58500 d) Oncorine

ANSWERS:

1) a	2) b	3) a	4) a	5) c	6) d	7) b	8) c
9) b	10) b	11) b	12) b	13) a	14) a	15) a	16) d
17) a	18) d	19) a	20) d				

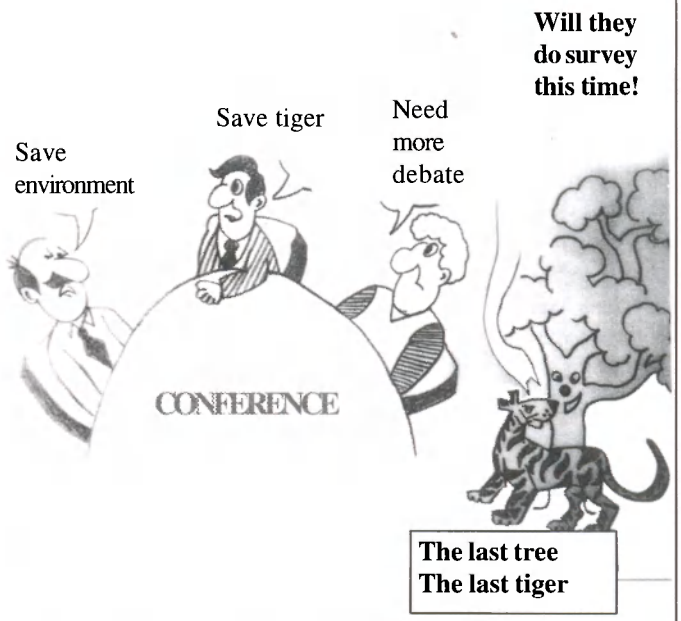
Contributed by Shri Jagdish Valecha, 102, Chinar CHS Ltd, 1st Floor, Plot No:593/A, 21st Road, Bandra (West), Mumbai 400050; Email: reliancethedon@yahoo.co.in, rishte1989@yahoo.in

BIOTECHNOLOGY
ORGAN CULTURE CLEARANCE SALE 2050



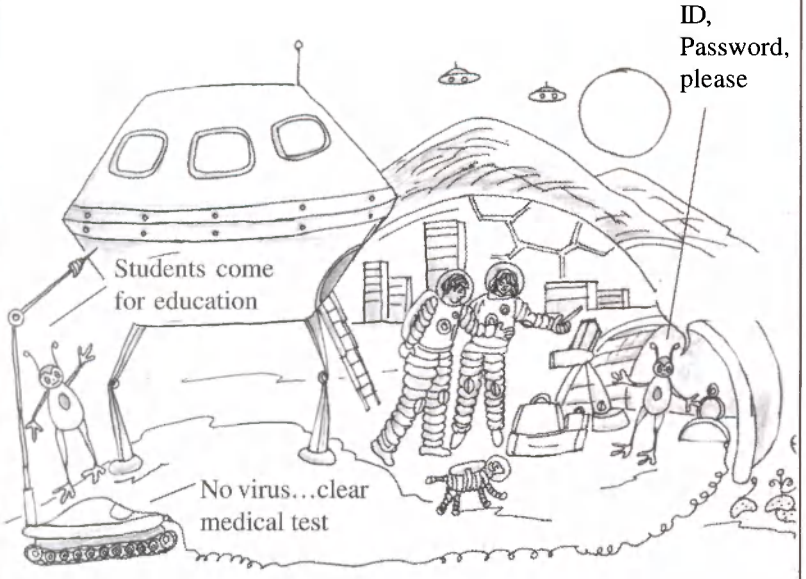
DR K K AMBASTA
PGT Biology, Sunshine prep/High School, Sherpur, Narayanpur, Myzaffarpur (Bihar)

CONFERENCE



SHRI YOGESH GAIROLA
144/7, Akashdeep Colony, Ballupur Road, Dehradun 248001

Man in space



Globalization to universalization...

SHRI SUJOY KUMAR DOLAI
C/o Shri Tarak Nath Dolai, Vill. Barabetia, PO Changual, Distt Paschim Midnapur 721301, West Bengal

The Earth

Threat from space in future by wastes & scrap of expired satellite & rockets.

SHRI SUJOY KUMAR DOLAI
C/o Shri Tarak Nath Dolai, Vill. Barabetia, PO Changual, Distt Paschim Midnapur 721301, West Bengal

Vainu Bappu
Father of Modern Indian Astronomy

(Continued from page 31)

The International Astronomical Union (IAU) holds its General Assembly once in three years at which the President would address the astronomers gathered from around the world. The 18th General Assembly was to be held in Patras, Greece on 23 August 1982. Bappu, as its President was looking forward to address the Assembly. On his way to Patras, he had a stopover at Munich, Germany. There he suffered a severe heart attack and had to undergo emergency by-pass surgery at the Munich Hospital. His wife Yemuna was with him. Just before the operation, he was planning to finish the Kavalur telescope project and getting the IAU to hold its 19th Assembly in India.

But fate had other designs. Two days after the surgery, complications developed and Bappu breathed his last on the afternoon of 19 August 1982. He was just fifty-five. His mortal remains were flown back to Bangalore and according to his wishes the ash was immersed in the river Kaveri. Bappu had traveled to that distant land to become one with those little twinkling stars, which he probed all through his career to understand them.

Condolences and tributes poured in at the IAU General Assembly at Patra, which he was to address. The news was received in India with shock, disbelief and profound sorrow. An eerie gloom filled the skies of Bangalore, Kodaikanal and Kavalur.

But the scientists and technologists at the IIA loved their leader too much to let grief overtake them. They rededicated themselves to the realization of Bappu's dream—the 2.34-meter stellar telescope at Kavalur. It was inaugurated and dedicated to the nation on 6 January 1986 by the then Prime Minister Rajiv Gandhi. He named it the Vainu Bappu Telescope and the observatory the Vainu Bappu Observatory.

Though Bappu was very good in studies, he had other qualities that made him an all-rounder. He was a gifted speaker, interested in sports, particularly cricket, and literature.

The IAU, during its 19th General Assembly held at New Delhi, honoured its past President by naming an asteroid after him.

Today, astronomy in India has grown leaps and bounds—not just in the optical wavelength but also along the entire electromagnetic spectrum, from infrared to gamma ray. It owes much to the vision and dedication of one man—M.K. Vainu Bappu.

Bappu was married to Yemuna, a post-graduate in political sciences. A charming, gracious hostess that she was, she took personal interest in the welfare of the staff members of the Institute. The Bappus had no issues. Yemuna lives in Koramangala, close to the IIA, whose staff even now fondly address her *"Amma"* and invite her to participate in all the functions of the Institute.

Dr M.S.S. Murthy retired as Head, Radiological Physics Division, Bhabha Atomic Research Centre (BARC), Mumbai. Address: B-104, Terrace Garden Apartments, 2nd Main Road, BSK IIIrd Stage, Bangalore- 560805

Science Reporter's

Science Fiction & Science Cartoon Competition

Results!

Science Fiction Competition 2010

Best Entry: *Mirror, Mirror on the Wall!* by Shripad Dharkar
Second Best Entry: *Head Louse Turns Super Bug by* Samiya Fatima
Third Best Entry *Atrophy by* Pranab Mazumdar

Science Cartoon Competition 2010

Best Entry: *Wake up* by Deepa S. Kumar
Second Best Entry: *Water Crisis* by Rehan
Third Best Entry: *Newton's Way to Catch the Lion* by Prateek Gupta
Fourth Best Entry: *The Natural Time Machine* by Mansi Mandal

The winning entries would be published in the forthcoming issues of *Science Reporter*.

CONGRATULATIONS WINNERS!

From Logic to Artificial Intelligence

NIDHI CHOPRA

There is logic in the laws of nature, there is logic in human action...well, mostly. Logic has led us to artificial intelligence. Where do we go from there?

Lighting a fire

LOGIC is one of the major sub-topics of subjects like mathematics, computer science and physics. Any science student familiar with Boolean Algebra knows about gates (NOT, OR, AND) and rules or principles of this Algebra. Aristotle was the first one to talk about this notion of distinction between true and false. This was called syllogism.

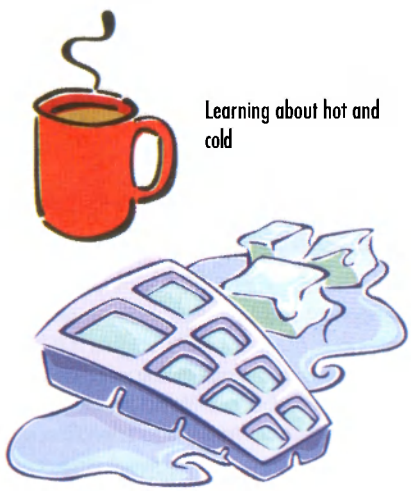
There are various other contributors of logic, and many other categories of logic. But is logic limited to such studies? No. It exists in our everyday life like mathematics. Various fundamentals of Science (Physics, Chemistry, and Biology), Psychology, and Philosophy that we use are in fact logic. Logic is all around us.

Logic existed when our ancestors learnt to light a fire using stones. "If I strike two stones, I can light a fire." Human beings must have learnt laws of life very practically, by observing life around them.

Today, logic exists in business, movies, fashion and media. "If it is a comedy film, it will make more money." "If it is hot, light colours would keep me cool." "Spicy gossips make channel popular." So, logic is everywhere!

In Daily Life

When you were a kid, you learnt not to touch a cup of hot tea. "If I touch a hot thing, I may get burns." This is a logic we learn by making mistakes – once, twice or even thrice – or from elders around us. As we grow up, our food intake increases. "If I am growing, I would need more food." As we go to school and college for education, we learn more about the principles of life. "If I work hard, I will succeed." Or, "hard work implies success."



Learning about hot and cold

There are representations for such rules as follows:

Character is lost, Everything is lost.

You behave badly with people, People behave badly with you.

Sow good, Reap well.

Some Categories of Logic

We observe people and learn about various places and cultures using such observations or patterns. For example, when we meet 2–3 students of a school or college, we may generalize that, since those three were serious students, all the students must be serious. (A good caution would be to say that most of the students must be serious in this college.) This is called *inductive logic*.

If there is gravity, things will fall down. This is another statement that is a result of generalization through observations.

A mathematics teacher, while teaching geometry, tells the students that all the circles have a centre. She then draws a circle on the board. Now this circle has to have a centre because all the circles have a centre. This is called *deductive logic*.

Observing serious students in an institute makes a generalized image in the mind about that institute

Contradictions

There are various paradoxes or contradictions. One such interesting paradox is Sorites paradox or paradox of heap.

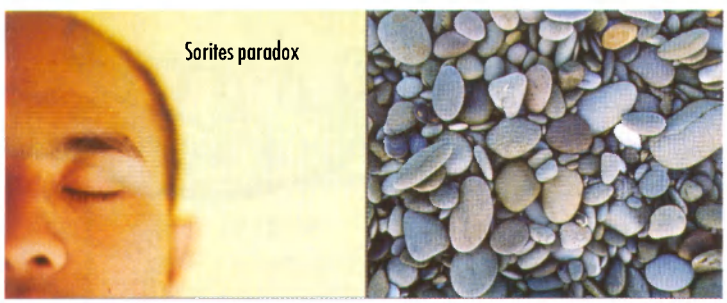
Consider hair on your head. If you remove one hair, it does not make a difference. If you remove one more hair, it still does not make a difference. We may say – removing a hair makes no difference to the hair on our head. But if we continue this process for more and more times, finally there are no hair left on the head. Thus what we generalized "if you remove a hair, it makes no difference" – is wrong in the long run. Logic should be used carefully!

Fuzzy – The Ambiguity in Life

Logic as we understand it is different from the logic that the modern digital device is made to understand. If a person says – "Delhi is too hot in summers," another person would understand, but the machine does not, because it can't comprehend 'too hot'. How much hot is 'too hot'? This answer may vary from person to person. But all would agree to a certain range of temperature – say 40°C or above.

Like wise other categories may be decided – too cold, cold, normal, hot, too hot. More categories may be added as per need. This idea is the base of fuzzy logic. This is an advanced form of logic or mathematics. Fuzzy is a continuization or extension of sets (8th class mathematics) to continuous models or paradigms.

Similarly, in the milk and sugar example, meaning is to be conveyed properly. 'Too less sugar' or 'too much sugar' makes milk distasteful where as 'normal sugar' (i.e. one table spoon) would be optimum to make it tasty.

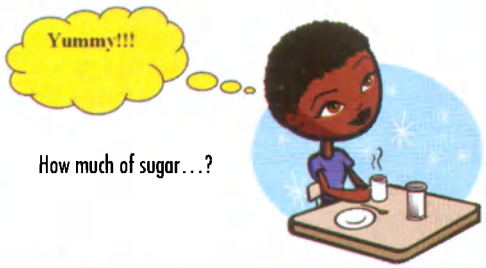


Sorites paradox

"If you remove a hair, it makes no difference" – is wrong in the long run. Logic should be used carefully!

Similar is the case when you remove stones from a heap. Work this one out your self.

When we add a few grains of sugar to our drink, say milk, it stills remains tasteless. But as we add more grains of sugar, the taste is sweet and now appealing. Adding more grains again makes it less appealing. We should not generalize that adding sugar always makes milk tasty. We will now understand more about it.



Logic and AI

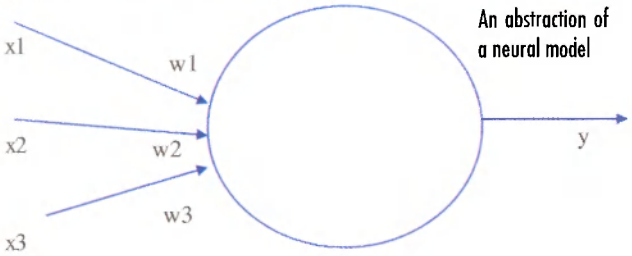
Logic draws heavily from subjects like biology, psychology and philosophy. Logic gave birth to many fields and interesting studies. One such field is AI (Artificial Intelligence). Artificial Intelligence is about making such devices (hardware) and programs (software) that help in automating the system. In other words, it is minimizing human interference to the least because complete absence of human supervision is very difficult to achieve---of course, it could be possible sometime in the future.

If you are looking for a more bookish definition, AI is making machines that can work without our help. AI is behind many subjects like data mining, robotics etc. It is a diverse, practical and advanced form of computing. It is more than doing 1+1=2 or 2+2=4.

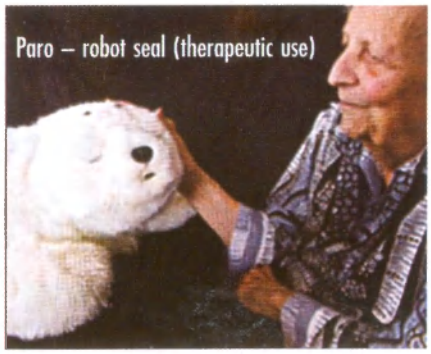
Patterns

Data mining is finding patterns in your data. For instance, suppose you have a sweet shop. You make bills and database of all the purchases in your shop. When you analyze your data, you will find out some implicit or obvious facts like – sale is high during festival time. Some other facts like when a people are accompanied by their children, they generally buy more. Some more useful ones like – which sweets sell more? Maximum customers are coming from which locality? Based on this you can make a plan (and in turn wealth) – which sweet's production should be increased? Where to open the new outlet of your sweet shop? For this decision you need to keep a record of customers' addresses. Whether to provide home delivery service or not? For this last decision you need to

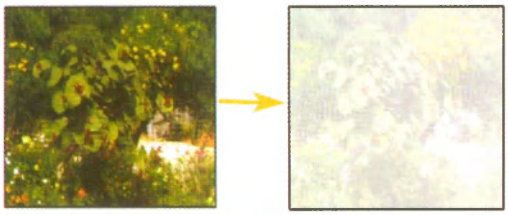
Observe sale patterns and get supplies accordingly



An abstraction of a neural model



(Reproduced from "Paro the Robotic Seal Could Diminish Dementia" - http://spectrum.ieee.org/robotics/home-robots/paro-the-robotic-seal-could-diminish-dementia - 31st May, 2010)



Watermark

Genetic Algorithm is inspired by biological evolutionary techniques like inheritance, mutation, selection and cross over.

collect customer feedback. Data mining helps in making decisions.

More knowledge can be derived from this data – like "50% of my customers are kids, so I should keep toffees, cakes and chocolates as well in the store because there is a 50–50 chance that my next customer would be a kid." Rules derived soon become your business common sense or wisdom – sale falls during heavy rains, more people come in the evenings etc. We are finding reasoning and relationships in data. This is the base of rough set theory – another higher subject. The word 'rough' indicates approximations.

Neural Networks and Genetic Algorithms

As the names suggest these two branches of AI are biology based.

Neural Networks is about training your data on the basis of existing examples. The knowledge gained from training data sets is used on fresh data sets. This technique is used in image recognition.

Here is a practical analogy to understand this. Suppose you ask for an advice from your parents, teachers and elder brother or sister. They all give you their opinions, suggestions and all. Whose advice would you consider the most? Your priority order may be like – parents (parents and grand parents are first teachers of the child), teachers and elder sister or brother. You are attaching some weight (w_is) or factor of importance to their views (x_is) and y is your final conclusion. This leads to the backpropagation model that finds many commercial and industrial applications.

In the actual model, training sets are used to obtain these weights. Then once the satisfactory values are obtained, we use them on actual/real data to find y. You study more obout this in higher classes.

Genetic Algorithm (Evolutionary Computing) is inspired by biological evolutionary techniques like inheritance, mutation, selection and cross over. It is about finding exact or approximate solutions to problems. It is used to solve difficult scheduling problems. It searches for best solutions in a solution space.

The word evolution itself suggests Darwinism – survival of the fittest (solution). Strategic games use GA to evolve the behavior of characters and events. GA is used for watermarking. It is also used in color quantization where you decrease the information (colouration) in an image to save memory and other resources.

Robotics

Robotics is a favorite theme for sci-fi movies and cartoons. Around the world scientists are making robots that can do house hold work, help humans in office work, play with children, aid the old, disabled and ill people, and even work in inhospitable terrains.

Some scientists and organizations are trying to achieve higher levels – making machines that can sense and feel. But is it a good thing? On the one hand we expect human beings to work and act without feelings and emotions and on the other hand we want machines to think, feel and sense.

If your entire office staff consists of robots than you may not actually need artificial intelligence. An all robots staff would mean – every thing can be done in terms of yes and no, true and false, black and white. There is no need of 'may be', 'partly', grey' etc.

AI is for assisting humans, not replacing them. We need intelligent machines to work with us as helpers. Such machines have to exist in a human world, deal with humans and their situations and data. Everything we have discussed here is for human perspective.

Logic was there even when we were not here. It exists in nature, in its patterns. In

Fern plant – pattern with in a pattern

the pattern of leaves of a fern plant, seashore or coastal lines, mountains, petals of flowers, shapes of birds, animals, we humans – logic and mathematics are everywhere. Some events or objects exhibit regularity in terms of irregularity – recurrences. This is the idea behind chaotic systems or chaos.

When we destroy Mother Nature, there is pollution and global warming. These are nature's reaction to our action. We disturb goddess nature, she disturbs us. Logic exists in even the laws of nature.

Ms. Nidhi Chopra is a Research and Teaching Assistant in the School of Computer and Information Science of IGNOU. She is doing research in E-learning. Address: B – 126, Gujranwala Town, Part–1, Delhi–110009; Email: nidhi.chopra@gmail.com

Prize Puzzle

BOILING AN EGG

Suppose you would like to boil an egg for exactly 15 minutes. But you only have two hourglasses, one of seven and one of eleven minutes. What is the fastest way to do this?

Solution:

_____

_____

_____

_____

"SOME" CLUE

On the basis of the clues given below, find the biological terms suffixing "some". The number of words in the answer, apart from "some", is given in brackets.

1. Another name for sex chromosome ——— (4)
2. Modified golgi body found in sperm ——— (4)
3. Thread like structure that appears during cell division, inside nucleus——— (6)
4. It encloses centrioles and takes part in cell division ——— (6)
5. A type of junction that attaches one cell to its neighbour ——— (5)
6. Another name for golgi body ——— (6)
7. A genetic element in bacteria that can replicate free in cytoplasm ——— (3)
8. Membrane bound compartment that forms a transport pathway from plasma membrane to the cytoplasm ——— (4)
9. Another name for basal body formed from centriole ——— (6)
10. Suicidal bag of the cell ——— (4)
11. Artificially prepared vesicle made of lipid bilayer that can be used to deliver drugs for some diseases ——— (4)
12. Convoluted invagination of bacterial cell membrane ——— (4)
13. Organelle containing melanin ——— (6)
14. A chromosome having no homolog especially in unpaired X chromosome ——— (4)
15. Repeating units of DNA observed as beads in eukaryotes ——— (6)
16. Cluster of ribosomes bound to m-RNA ——— (4)
17. Large protein complexes inside cells of all eukaryotes and some bacteria ——— (6)
18. Protein synthesising factory of a cell ——— (4)
19. A large, specialised mitochondrion found in striped muscle ——— (5)
20. It is an isolated terminal of a neuron ——— (7)

Contributed by Dr. K. Venkataramana,
A T 2 Porkudam apartments, Bypass road,
Madurai-625010

SOLUTIONS TO PUZZLES PUBLISHED IN THE JANUARY 2011 ISSUE

PRIZE PUZZLE:

KNOW YOUR HUMAN BODY

THROM**B**OCYTES (6th word)

D**I**ALYSIS (2nd word)

LYMPH (1st word)

GLOM**E**RULUS (5th word)

B	**I**	**L**	**E**

PLAYS AN IMPORTANT ROLE IN DIGESTION OF FATS

SEARCH THE TOOLS

SCREWDRIVER	HAMMER	MALLET
CHISEL	SAW	TROWEL
SHOVEL	FILE	SCRAPER
TRY	SQUARE	PUNCH
ANVIL	TONG	CLAMP
SCISSOR	GOUGE	PLANE
BRACE	PINCER	NEEDLE
DRILL	LATHE	WRENCH
SCRIBER	VICE	

THE NAMES OF THE PRIZEWINNERS BASED ON A DRAW OF LOTS FROM AMONG THE CORRECT ENTRIES ARE:

1. **Shivika Malik,** 123-A/24-A, PGI Flats, Chandigarh-160023
2. **Varun Karmarkar,** B-6-101/B, West Marredpally, Secunderabad-500026
3. **Meenakshi Bose,** A-486, Kalkaji, Double Storey (FF), New Delhi-110019

Congratulations all the winners!

Sensational Sue: Queen of Dinosaurs

TYRANT lizard king. That is the meaning of the name *Tyrannosaurus rex*, which everyone knows, was a flesh-eating dinosaur. It is now, thankfully, quite extinct.

T. rex as it is familiarly called has been described thus by Roy Chapman Andrews, "*When erect on his two hind limbs, he was 18 ft* (5.5 m) *high. The small forelimbs were equipped with large talons. The great mouth opened a yard wide and was armed with double-edged dagger like teeth six inches* (15 cm) *long. Its food was the flesh of other dinosaurs.*"

Sue is the nickname for the largest, most complete and best-preserved skeleton of *Tyrannosaurus rex* found till date. Her name pays tribute to her co-discoverer American paleontologist Susan Hendrickson.

Sue was discovered in 1990 in a cattle ranch in South Dakota, USA. It was owned by Maurice Williams. Fossils of animals and plants that inhabited Sue's world were found alongside her bones. The preponderance of water plants, fishes, crocodilians, and amphibians indicate that she lived—and died—near a river.

The discovery itself was serendipitous. The group that had been excavating nearby areas was scheduled to leave when their truck developed a flat tyre. While the others went to town to get it repaired, Sue decided to hunt round a bit more. Walking along the base of a cliff, she discovered some small pieces of bone. Looking up she spotted larger bones sticking out from the cliff. American palaeontologist Peter Larson studied the small bones and pronounced them to be *T. rex* bones.

It took six people 17 days to free Sue from her rocky prison. Once the skeleton was fully excavated, a legal dispute arose over who owned the fossil: the owner of the land or those who had found the bones. After a lengthy trial, the verdict was delivered in favour of Maurice Williams. The fossil was auctioned off in 1997. The Field Museum in Chicago put in the winning bid and purchased her. It is only then that the real work began.

Sue's bones were embedded in matrix that had to be cleaned off. Once the matrix was removed, the clean bones were photographed. Then palaeontologists began to scrutinize them and put the skeletal puzzle together. Some bones were sent for CT scanning. Interestingly, the skull was so large that it had to be scanned using the CT scanner used to inspect parts of the space shuttle. Amazing as it sounds, scientists found that the cellular structure inside the cross sections of bones is still quite intact.

What they still do not know, however, is if the animal was male or female. Some researchers argue that the large skeletal size suggests that Sue was a female...so, we will continue to use the feminine gender when referring to Sue.

We now know that Sue lived about 67-65 million years ago. Sue's skeleton is extremely well preserved; marks where muscles and tendons once attached to them are still clearly evident. Sue's bone count totals 224 of the 321 known bones. Her claim to fame is also that this is the first skeleton of a *T. rex* in which a wishbone has been found, as also the stapes (an ear bone).

Reportedly, her skull contains the longest (and no doubt, the scariest) *T. rex* tooth recovered till date. Studies of Sue's bones in the feet indicate that she, and others of her ilk, probably walked at about 10 km/h and ran at not more than 24 km/h. Sue is 12.9 metres long. The height at her hips is 4m. Her estimated weight in life is about 6.4 metric tons.

It is almost impossible to state with certainty what killed Sue. We cannot even be certain if she was killed or simply died due to natural causes. However, it is clear that she had a hard life as evidenced in broken ribs and the injured arm. But then, this is only to be expected in a carnivorous dinosaur: a top predator the size of Sue!

Close study of her bones has revealed that Sue had a condition that resembles arthritis. Was she then very old as T. rexes go? It does seem that way. As palaeontologist John Flynn puts it, "*Here is a very, very old dinosaur that just got sick and died after a long, active life.*" The question is how old did *T. rex* get before old age caught up? Nobody can really say, but experts agree that Sue was about 28 years old when she died.

Sue was, and remains, a sensation millions of years after she died. More than 10,000 visitors queued up on 17 May 2000 when she debuted at Chicago's Field Museum of Natural History, USA. Since then, more than 16 million visitors have marvelled over her. It was clear that she could still turn heads, hog headlines, trigger debates and win hearts...the quintessential hallmark of a *femme fatale*. (The pun is intended...for Sue was a killer machine. An encounter with her would have been fatal anyway.) No wonder, Sue remains, as many call her, the Queen of Dinosaurs. *Regina*, not *rex* if you want to say that in Latin..

Dr Sukanya Datta
Scientist NiSCAIR posted to Director General's Technical Cell, CSIR HQ
Email: sukanya@csir.res.in

Research into fuel cell technology holds out the promise of clean and abundant energy in the future.

THE search for alternative fuels for a sustainable economy and conservation of the environment has brought fuel cell technology to the forefront. A fuel cell creates electric energy by converting a fuel into a negative charge on one terminal and a positive charge on the other terminal. It converts chemical energy of a fuel into electrical energy without the internal combustion steps of a heat engine.

Such conversions are possible because the combustion reactions are also redox reactions in nature. That is why a fuel cell uses lightweight but active oxidants and reductants as its fuel. It creates electric energy from a fuel (input on anode side) and an oxidant (input on cathode side) in the presence of an electrolyte. While the electrolyte remains permanently inside the cell, the reactants flow in and byproducts flow out.

When a load is connected across a fuel cell the current flows. When it powers a load like car, bus, autorickshaw etc. the fuel is slowly consumed. It works continuously as long as the oxidizing and reducing agents are supplied at the electrodes.

A fuel cell does not come under the category of either primary or secondary cell. It differs from a secondary cell in that it cannot be charged in the conventional manner. It is also different from a primary cell in that it consumes reactants that must be replenished continuously and not prepacked.

The materials used in fuel cells differ by type because many combinations of fuel and oxidants are possible. The most commonly used fuel cell is the hydrogen cell that uses hydrogen as fuel and oxygen as oxidants. However, a fuel cell does not create any pollution and so can play a leading role in meeting the national goals of clean air, climate protection and energy security.

History of Fuel Cells

The principle of the fuel cell was discovered by German scientist Christian Friedrich Schonbein in 1838. He found that a phenomenon opposite to electrolysis of water could create electric energy.

The first fuel cell based on this principle was built in 1845 by Welsh scientist Sir William Grove. He discovered that immersing the ends of two platinum electrodes in sulphuric acid and each of

FUEL CELLS: HOPE FOR FUTURE ENERGY

M. GOSWAMI &
S. SAHOO

Fuel cells were also extensively used on Apollo missions and on current space shuttle programmes fuel cells continue to be the main power supply unit.

the other two ends in separate sealed containers of oxygen and hydrogen would cause a constant current to flow. By combining several such cells in series circuit he created a battery, which he named gas battery.

Later, several scientists worked on different combinations of reactants, electrolytes, electrodes and catalysts. However, fuel cells garnered serious interest in the 1960s when NASA chose fuel cells over risky nuclear and bulky and expensive solar energy. The fuel cell was soon proved to be a compatible and reliable energy source to all manner of electrical devices. Today, it continues to be the sole supplier of fuel to space shuttle programmes of NASA.

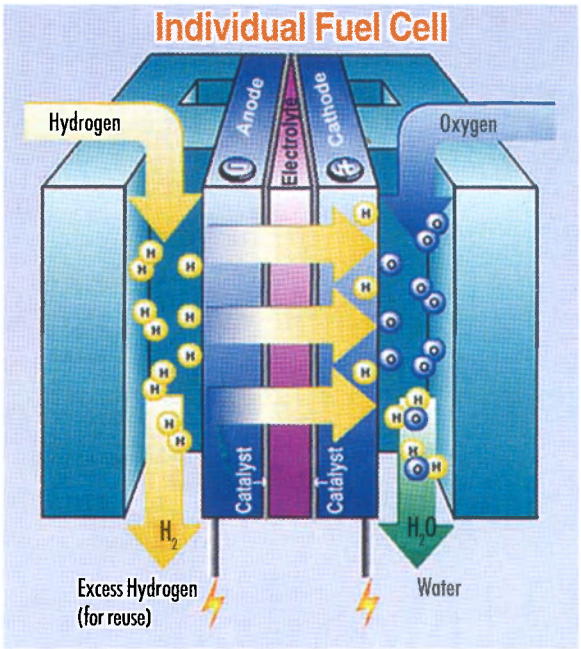
Fuel Cell System

The hydrogen-oxygen (H_2–O_2) fuel cell has been by far the most successful research in this field. It works on the principle of catalysis, separating the electrons and protons of the reactant fuel at one electrode, and forcing the electrons to travel through a circuit, converting them to electric power. Another catalytic process takes the electrons back to another electrode, combining them with the protons and oxidants to form waste products.

Broadly, the H_2–O_2 fuel cell is made from the following components: (i) the electrodes (ii) the electrolyte, and (iii) the catalysts.

(i) Electrodes: The bipolar plates or electrodes are usually made of carbon nanotubes. The negative post of the cell, the anode, conducts electrons freed from the hydrogen molecule that are used in the external circuit to maintain current. Normally hydrogen atoms do not dissociate into protons and electrons. But in a fuel cell, hydrogen atoms enter at the anode where a chemical reaction strips them of their electron. This reaction takes place in the presence of a catalyst. The energy for this dissociation comes from the thermal energy of the surrounding air. The positive post of the fuel cell, the cathode, conducts electrons back from the external circuit to the catalyst, where they are

A fuel cell system running on hydrogen can be compact and lightweight and has no major moving parts.



recombined with hydrogen ions (protons) and oxygen to form water.

(ii) Electrolytes: The H_2–O_2 fuel cell uses concentrated aqueous solution of alkalis like KOH or NaOH. This is called Alkaline Fuel Cell (AFC). This alkaline electrolyte is a specially treated material that conducts positively charged ions (protons) exclusively and blocks electrons. A fuel cell using such an electrolyte is termed a Proton Exchange Membrane Fuel Cell (PEMFC).

(iii) Catalysts: To accelerate electrode reactions, suitable catalysts are added to the porous carbon electrodes. The reaction between hydrogen and oxygen at the operating temperature (400K) of the cell is not very fast. Hence, the presence of catalyst accelerates various chemical reactions involving hydrogen and oxygen at the electrodes. The catalyst, often made from fine platinum or palladium powder or nano iron powder coated on to carbon paper or cloth, is used at the anode to induce the hydrogen atom to freely dissociate into protons and electrons.

Materials used in the fuel cell differ by type. The bipolar plates or electrodes are made of metals, like nickel or carbon nanotubes and are coated with catalysts like palladium, nanoiron powders or palladium for higher efficiencies. A carbon paper separates them from the electrolyte.

Fuel cell developers are often constrained by the choice of electrolyte. The design of electrodes and the materials used to make them depends on the electrolyte. The main electrolyte types used these days are alkali, molten carbonate, phosphoric acid, proton exchange membrane and solid oxide. In H_2–O_2 fuel cell a proton conducting polymer membrane is used as electrolyte.

Depending upon the electrolytes, hydrogen–oxygen fuel cells can be classified as: (a) aqueous, (b) non-aqueous, and (c) hybrid.

Aqueous cells are metal or carbon electrodes and operate at low temperatures, incorporating electrocatalysts. In such cells very strong acids or alkaline electrolytes are used. The non-aqueous cells are invariably fused salt or solid electrolyte system. The ion/proton exchange membrane serves dual purposes. The solid polymer membrane takes the role of the electrolyte and the cell works at low temperature like aqueous system. So, it is of hybrid type.

The type of fuel also depends on the electrolyte. Some cells need pure hydrogen and therefore demand extra equipment such as a reformer to purify the fuel. Other cells can tolerate some impurities, but might need higher temperature to run efficiently. In addition to pure hydrogen type, there are hydrocarbon fuels for fuel cells including diesel, methane, ethane, methanol and chemical hydrides. The waste products of these types of fuel cells are carbon dioxide and water.

Larger fuel cells use fuel exchanger, a device that converts any hydrocarbon fuel into hydrogen and other components. In fuel cells using pure hydrogen and oxygen, water is the only waste product. The theoretical efficiency of the hydrogen–oxygen fuel cell is 83%. But the actual efficiency of the fuel cell is 60 to 70 %. It is still regarded better in terms of efficiency of thermal power plants (40%).

Fuel Cell Design Issues

There are several issues related to design of fuel cells that need to be taken care and managed effectively.

(i) Temperature management: In H_2–O_2 fuel cell temperature management is particularly challenging as $2\ H_2 + O_2 = 2\ H_2O$ reaction is highly exothermic, so a large quantity of heat is generated within the fuel cell. In order to prevent damage to the cell due to thermal loading the same temperature must be maintained throughout the fuel cell.

(ii) Water and air management: In proton exchange membrane fuel cell, the membrane must be hydrated, requiring water to be evaporated at precisely the same rate that it is produced. If the water is evaporated too quickly, the membrane dries, resistance across it increases and eventually it will crack, creating a gas short circuit, where hydrogen and oxygen combine directly, generating heat that will damage fuel cell. On the otherhand if water evaporates too slowly, the electrodes will flood, preventing the reactants from reaching the catalyst and stopping the reaction. The management of water in cells is being developed like electroosmotic pumps (osmosis in presence of electric field) focusing on the flow control. Like a combustion engine, a steady ratio between the reactants and oxygen (air) is necessary to keep the fuel cell operating properly.

(iii) Activation loss management: In fuel cell, voltage decreases as current increases due to several activation factors. Due to resistance of the cell components and interconnects ohmic loss occurs and voltage drops. Hence, resistance of the


Golf Cart

Bicycle

Car

fuel cell components needs to be maintained for a steady voltage. Moreover, the depletion of reactants at catalyst sites under high load causes rapid loss of voltage. This is called mass transport loss.

Benefits & Drawbacks

Fuel cells are the only technology that can provide pollution free energy for both transportation and electric utilities. Fuel cells are reliable, easy to maintain and safe. They can be fabricated in a wide range of sizes without sacrificing either efficiency or environmental performance. This flexibility allows fuel cells to generate power in efficient manner for automobiles, utilities and buildings.

Fuel cells are used as power sources in remote locations, such as spacecraft, remote weather stations, large parks, rural locations and in certain military applications. A fuel cell system running on hydrogen can be compact and lightweight and has no major moving parts.

Since fuel cells have no moving parts and do not involve combustion, they are safe for space programmes. The alkaline fuel cell was first used by NASA and McDonnell Aircraft during project Gemini mission. Fuel cells were also extensively used on Apollo missions and on current space shuttle programmes fuel cells continue to be the main power supply unit.

Now-a-days fuel cell is also used for back-up power in hospitals and factories, and increasingly for city and university buses, and airports. Proton Exchange Membrane Fuel Cells (PEMFCs) are used for transportation, demonstrations and small-power applications. PEMFCs are also used to power a car, bus or an autorickshaw.

However, there are certain drawbacks as well. For instance, a single fuel cell only produces approximately 0.7 volts. In order to produce large quantities of electricity, we require many cells. When combined in series it yields higher voltage and when combined in parallel it allows a stronger current to be drawn – such a design is called a "fuel cell stack". Besides, it is difficult to use hydrogen as fuel due to difficulties of storage and distribution.

New Developments

The technological development of fuel cell has been oriented to address two major difficult areas related to fuel cell. They are (i) High cost of fuel cell due to use of expensive material like platinum as catalyst, and (ii) Hydrogen economy.

Recent (2009) research from the University of Dayton has shown that arrays of vertically grown carbon nanotubes could be used as catalyst in place of platinum to reduce the overall cost of the fuel cell. The nanotubes that are doped with nitrogen prevent the carbon from reacting with oxygen and forming carbon monoxide (CO), called CO poisoning. Nitrogen doped nanotubes are more resistant to this carbon monoxide corrosion and would be long lasting and cheaper than the expensive platinum catalyst used now.

Another group of scientists from Max Planck Institute for Solid State Research has composed a network of single walled carbon nanotube electrodes that boast of the same properties of amorphous carbon electrodes used earlier, but weigh far less. These nanotube electrodes are ten times thinner and lighter than the traditional electrodes. The long and thin shape of such nanotubes not only increases the surface area and porosity of the electrodes but also gives them high conductivity, more than one thousand times larger than the amorphous carbon electrodes. It is now believed that the use of carbon nanotubes in fuel cell will lead to much simpler fuel cell architecture.

It is now believed that the use of carbon nanotubes in fuel cell will lead to much simpler fuel cell architecture.

Another recent advance in the field of fuel cell is the development of a highly efficient electronic converter that can boost low DC (Direct Current) voltage produced by Solid Oxide Fuel Cell (SOFC) stacks to the higher voltage required for conversion to AC (Alternating Current) for household and commercial application.

Production of Green Hydrogen from renewable sources has been taken up as a challenge by United Kingdom for hydrogen economy. Novel technologies have been adopted for low carbon emission hydrogen production, for development of materials for hydrogen storage and transportation.

China is studying the development of an appropriate hydrogen infrastructure system to achieve fuel cell vehicle commercialization. Many in China feel that chemical companies producing enough hydrogen as an unneeded industrial byproduct can meet the need.

In India several industries and research organizations are involved in the development of fuel cell. The Defence Research and Development Organization (DRDO) and Reva electric car company jointly displayed the first fuel cell car of India in 2007 and expect the car to reach the mass market soon. The development of Direct Methanol Fuel Cell (DMFC) is also under way at IISc, Bangalore.

Dr M. Goswami is with the Department of Physics, Regional Institute of Education (NCERT), Bhubaneswar-751022, Orissa; Email: manasigoswami1@yahoo.com
Dr S. Sahoo is with the Department of Physics, National Institute of Technology, Durgapur–713209, West Bengal; Email: sukadevsahoo@yahoo.com

Know your Palm Trees

GIRIJA DURGAPAL

MOST PALMS ARE DISTINGUISHED BY THEIR LARGE, COMPOUND, EVERGREEN LEAVES ARRANGED AT THE TOP OF AN UNBRANCHED STEM. HOWEVER, PALMS EXHIBIT AN ENORMOUS DIVERSITY IN PHYSICAL CHARACTERISTICS. IDENTIFY THESE COMMON PALMS.

1. It is *Cycas revolute*. It is not really a palm at all. It is a member of the ancient Cycad group of plants that are the oldest seed-producing plants on earth. Its common name is....
a. The Sago Palm
b. Bottle Palm
c. Date Palm
d. Betel Palm

2. It is *Hyophorbe lagenicaulis*. It is also called Champagne palm. It looks like a bottle. Its common name is....
a. The Sago Palm
b. Bottle Palm
c. Date Palm
d. Betel palm

3. It is *Phoenix dactylifera*. It is extensively cultivated for its edible sweet fruits. Its common name is....
a .The Sago Palm
b. Bottle Palm
c. Date Palm
d. Betel Palm

4. It is *Caryota mitis*. Its leaves are bi-pinnate, medium green and resembling a fishtail. It is....
a. Betel Palm
b. Fishtail Palm
c. Washingtonia Palm
d. Date Palm

5. It is *Washingtonia robusta*, named after George Washington, the first president of the United States. Leaves are palmate, up to 3-4 feet wide, bright green with filamentous fibres at the margins. Its common name is....
a. Fishtail Palm
b. Washingtonia Palm
c. Date Palm
d. Fan Palm

6. It is *Wodyetia bifurcate*. It is a very attractive palm with long (2-3m.) plumose leaves. Received its more commonly known name from the appearance of its foliage, which is in a shape of a fox's tail. Its common name is....
a. Fishtail Palm
b. Washingtonia Palm
c. Date Palm
d. Foxtail Palm

7. It is *A. catechu*. Several species are known for their bitter and tangy taste, raw or dried nuts, used for chewing with betel leaves. Its common name is....
a. Queen Palm
b. Betel palm
c. Bottle palm
d. Date Palm

8. It is *Cocos nucifera*. It is a large palm, growing up to 30 m tall. Coconut is the edible fruit of this palm. It supplies food, drink, shelter and raw materials for a number of industries. Its common name is....
a. Bismark Palm b. Coconut Palm
c. Bottle Palm d. Date Palm

9. It is The Royal Palm. The genus was named for Roy Stone, a U.S Army general during the American Civil War. They are distinguished by tall, smooth, columnar trunks and large pinnate fronds.
a. *Nypa fruticans*
b. *Elaeis guineensis*
c. *Sabal palmetto*
d. *Roystonea regi*

10. It is the King Palm. It has elegant curved smooth trunks when grown from seeds planted together. It has feather type branches. It is also known as Bangalow Palm.
a. *Nypa fruticans*
b. *Archontophoenix cunninghamiana*
c. *Sabal palmetto*
d. *Euterpe oleracea*

11. It is the Red Latan Palm. It is an attractive, medium to large, fan palm. When young, the stiff leaflets are distinctively tinged with red, hence this palm's common name.
a. *Latania lontaroides*
b. *Elaeis guineensis*
c. *Sabal palmetto*
d. *Euterpe oleracea*

12. It is the Chinese Fountain Palm. The large bright green fan-shaped leaves are deeply divided into about 75 segments that droop downward to give a fountain-like aspect inspiring its common name.
a. *Nypa fruticans* b. *Elaeis guineensis*
c. *Sabal palmetto* d. *Livistona chinensis*

13. It is the Majesty Palm. It is a very large palm with a large, untidy crown. It has symmetrical leaves and develops an attractive swollen base gradually tapering upward. It prefers living near rivers.
a. *Nypa fruticans*
b. *Elaeis guineensis*
c. *Ravenea rivularis*
d. *Euterpe oleracea*

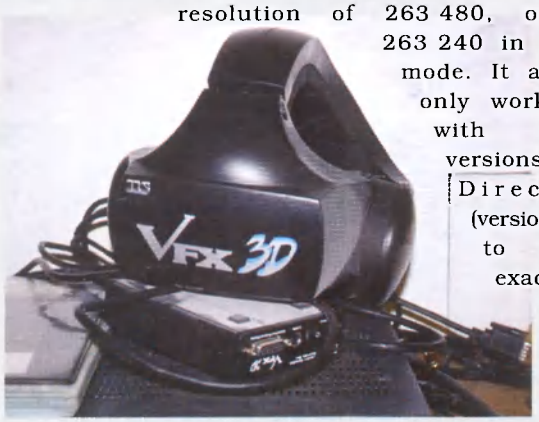
ANSWERS:

1. a 2. b 3. c 4. b 5. b 6. d 7. b
8. b 9. d 10. b 11. a 12. d 13. c

Contributed by Ms Girija Durgapal, c/o Dr Mahesh Chandra, H. NO. 158, Block -6, Sector 11, Rohini, New Delhi. Email: girijadurgapal@gmail.com

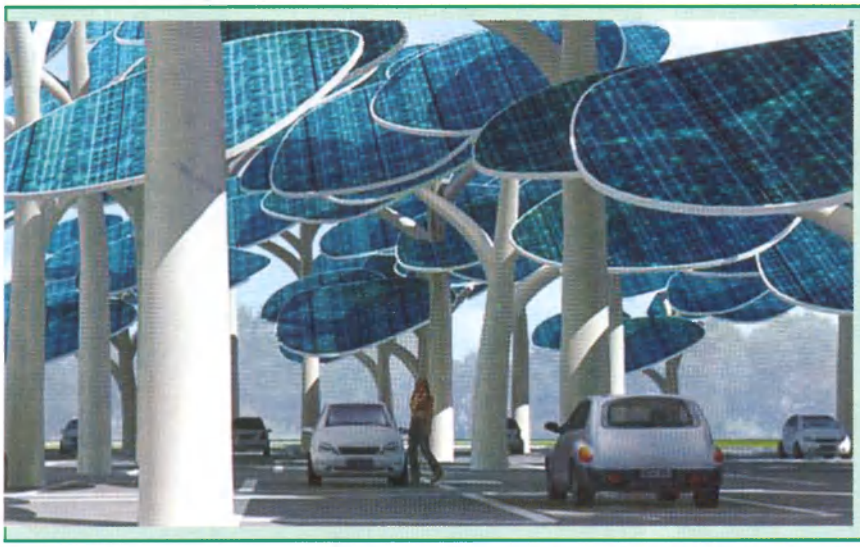
Virtual Reality Helmet

It is a rare virtual reality helmet. This helmet straps onto your head and covers your eyeballs with dual-stereoscopic 3D images. It also features early head-tracking tech that works with a handful of 3D PC games like *Descent 3* and *Unreal Tournament*. But before you get too excited about this thing, the tiny LCD displays only had a paltry resolution of 263 480, only 263 240 in 3D mode. It also only worked with old versions of DirectX (version 7 to be exact).



Biosphere Home Farming

The Biosphere Home Farming not only provides with the food you eat, but also delivers fresh hydrogen, heat and gas. The structure houses fishes, root vegetables, grasses, herbs, plants and algae under a common roof. The kitchen trash is used to nourish the farm, while the methane digester, which the system is equipped with, produces the much-desired heat and gas to power lights. Similarly, algae produce hydrogen that can be used to produce more electricity.



Solar Forest

The Solar Forest is a crafty design solution for charging electric vehicles and generating solar energy. The solar forest offers shade, free EV charging, solar energy generation while simultaneously greatly improving the appearance of the urban landscape. The solar forest has trees that are composed of photovoltaic leaves, which is responsible for collection of solar power. Each of the trees' trunks has a power outlet available for use in order to charge up an electric vehicle. Aside from charging, the photovoltaic leaves also provide shade to the car and its users while charging.

Digital Talking Compass

This little speaking compass can come very handy when you are out in the bush. It's the world's first talking compass. Just imagine driving your car in the bush and getting voice direction when you need it. With this gadget you will never get lost again. This compass is powered by two 12-volt batteries and can speak both English and Spanish.

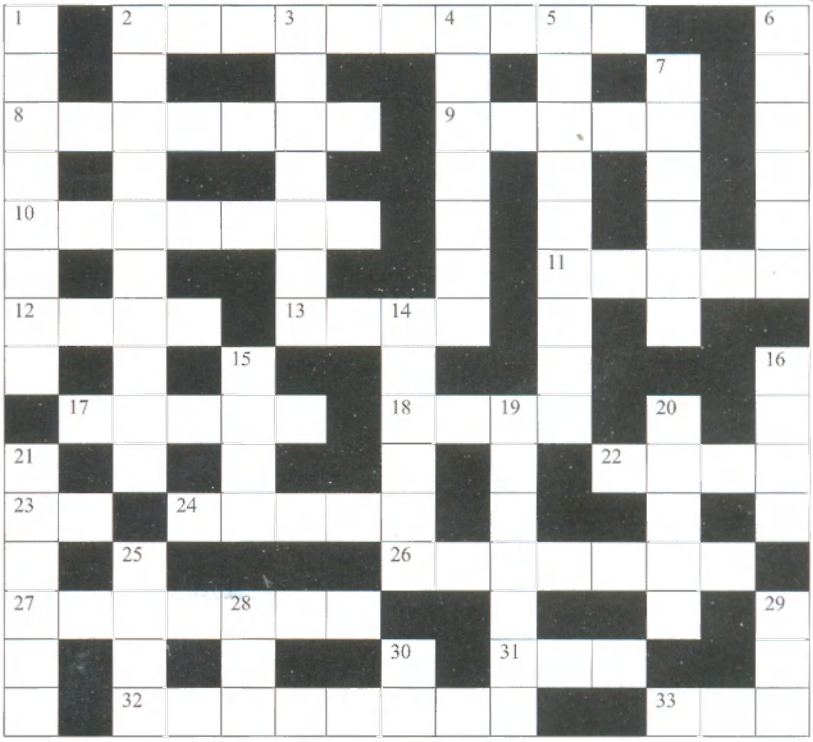
Electric Bike

The Electric Bike concept is sure to appeal to all workaholics as well as gadget junkies. This concept bike is definitely amazing. This is a battery supported electric bike. It has docking section for your laptop that is powered by the battery.

It also has ability to connect your laptop to built-in screen at steering, so riders have access to all the information they need at any moment. Might make riding in side winds a bit of a problem, it will act as a sail, especially in windy weather.

ACROSS

2. One of the worst weeds, commonly known as congress weed, which causes severe health problems in human and animals; reduces yield of crop and is a threat to biodiversity (10)
8. A pure chemical substance consisting of one type of atom, distinguished by its atomic number (7)
9. Group of organisms produced asexually from one ancestor (5)
10. Pertaining to nutrition (7)
11. A slit-like line running longitudinally on the valve of a diatom, indicating the position of a narrow slit in the wall (5)
12. Another name of the Lady's finger plant (4)
13. Abbreviation of a respiratory disease in humans, caused by coronavirus (4)
17. Common name of the narcotic plant Papaver somniferum Linn. (5)
18. Common name of the plant Phoenix dectylifera Linn., fruits called 'Chhuhara' (4)
22. A plant form that is assumed to be adapted to the habitat (4)
23. Symbol of a chemical element that has atomic number 22, also called 'space age metal' (2)
24. The skeleton of the vertebrate head that encloses the brain and sense organs (5)
26. Compound NH_3 is known as... (7)
27. Six-carbon containing important monosaccharide (carbohydrate) used as a source of energy and a metabolic intermediate of cells (7)
31. Atomic number of noble gas Neon (3)
32. A chromosome, other than a sex chromosome (8)
33. Abbreviation of the most famous chemical pesticide, first prepared by Zeidler (3)

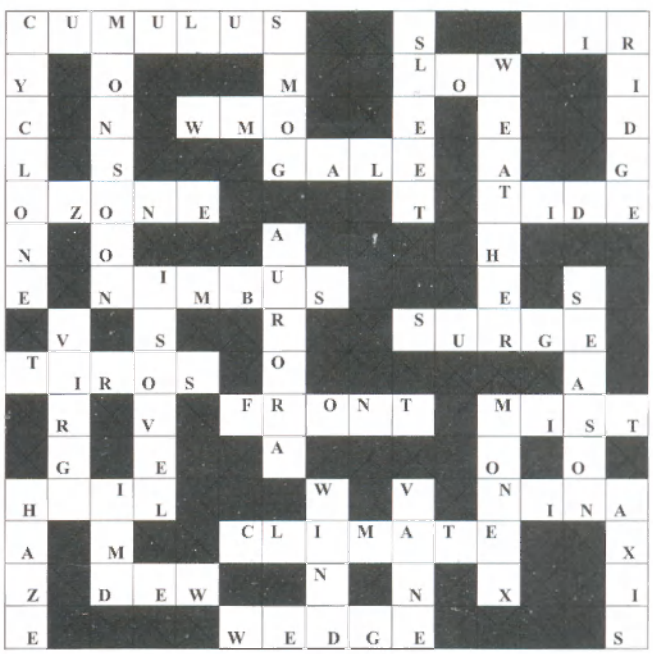


DOWN

1. A subatomic particle discovered by J.J. Thomson in 1897, carrying a negative electric charge (8)
2. The production of more than one physiologically uncorrelated effect by one gene (10)
3. A group of complex compounds containing phenols, hydroxyl-acids or glucosides, found in vacuole sap, cell wall, bark, leaves and unripe fruits, commonly used for hardening leather (7)
4. A cell organelle that contains hereditary materials in the form of chromosome surrounded and separated by a membrane (7)
5. Yellow pigment of urine that is probably derived from the bile pigment bilirubin (9)
6. A catalytic substance of living cells that speeds up some specific metabolic activity such as respiration, digestion, photosynthesis etc. (6)
7. A sugar fluid produced in the flowers having pollination through insects (6)
14. A ribbon-like organ of mollusk whose surface is studded with rows of horny teeth (6)
15. Long, pointed tooth of an elephant (4)
16. A flightless extinct bird since the 17th century, endemic to Indian Ocean island of Mauritius, related to pigeons and doves (4)
19. Common name of social insect white ant that live in huge nests tunneled in wood or built of earth and wood cemented together (7)
20. I-bands or J-discs of striated muscle (5)
21. Receptacle for pollen on flower that has gelatinous or visceral appearance (6)
25. A stage between the life of the larva and the adult of the insect in which it appears to be resting but in reality is undergoing many morphological and physiological changes (4)
28. Latin prefix which means eight (3)
29. A small social insect; also the Greek prefix of 'opposed to' (3)
30. A colorless, odorless and tasteless gas that is highly toxic to humans and animals; consists of one Carbon atom and one Oxygen atom (2)

Contributed by Dr. Sanjay Kumar, Near of primary school of Jagadishpur, Village Jagadishpur, P.O. Barawan, District Jaunpur-222143 (U.P.); Email: sanecc@gmail.com

SOLUTIONS TO FEBRUARY 2011 CROSSWORD



BARK DRUGS

An Introductory Guide

New Release

Adulteration and substitution of herbal raw materials, especially in case of bark drugs, is rampant. For instance barks of *Asoka, Albizia lebbek* and *Arjuna* are often substituted by barks of other species. The present publication, lays down quality parameters of 40 barks and their possible adulterants/substitutes.

The emphasis is on classical pharmacognostical and phytochemical approaches to determine the correct botanical identity of the genuine source of the plant material required to be used in number of herbal formulations. Parameters selected are: botanical name with authority; family; synonyms, vernacular names; botanical description; distribution; macro and microscopic description with special emphasis on diagnostic characters supported by photographs; powder microscopy with camera lucida drawings. Apart from this, thin layer chromatographic profile is also depicted by photographs to establish the diagnostic chemical profile of different bark drugs. In addition, all the stem barks were also screened for some terpenoids and polyphenols, as marker components, which are generally present in the bark drugs.

The information presented in this book will have considerable impact on the standardization and quality control of bark drugs as also checking their possible adulterants and substitutes. The book is a ready reckoner for pharmaceutical industries and academics, particularly researchers, teachers and students engaged in herbal drug research or study of indigenous systems of medicine.